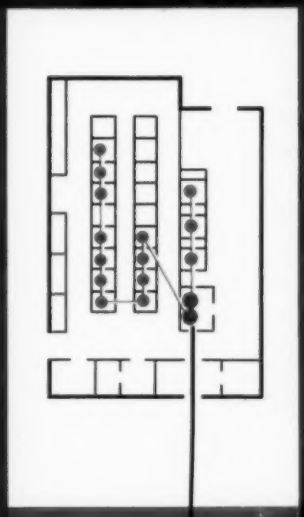
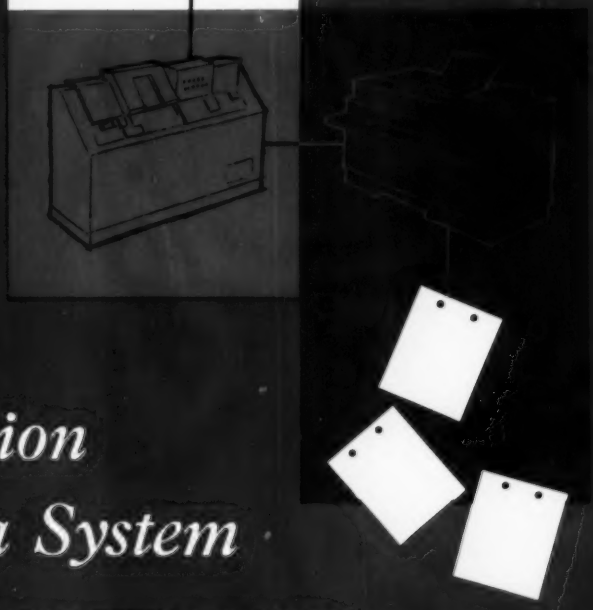
# AUTOMATION

JUNE 1960





# *Production Data System*

IMPROVES MANAGEMENT CONTROL

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS


- Manufacturing Research and Capital Costs
- Successful Automatic Assembly
- Techniques for Parts Handling
- Counting for High Speed Control

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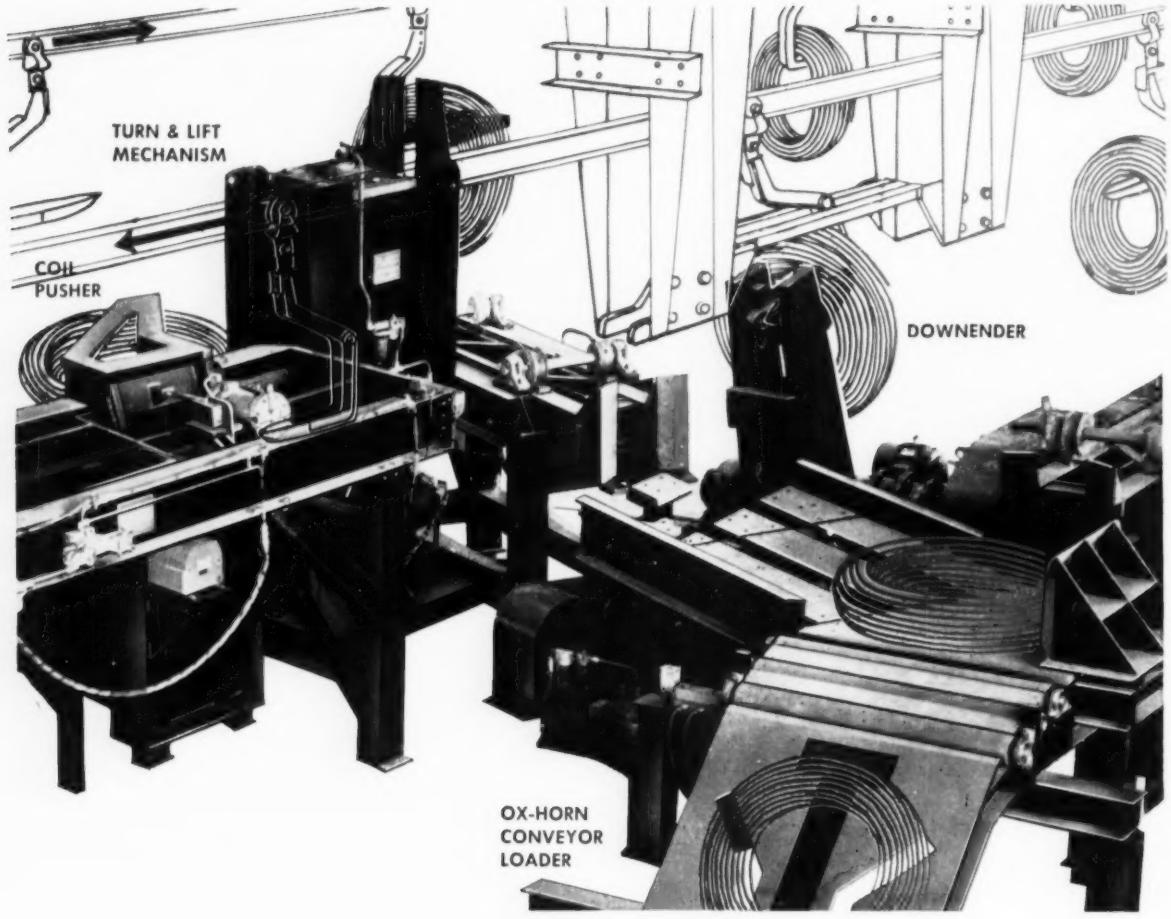
A PENTON PUBLICATION




## another example of Planet Versatility...

# COIL HANDLING SYSTEM LOADS AND UNLOADS EXISTING CONVEYORS AUTOMATICALLY

This automatic coil handling system is an example of how *Planet Versatility* helped one of America's largest steel mills modernize its 10-inch bar mill to handle larger, 2000-pound bar coils . . . and save money by designing the coil handling equipment to load and unload *existing* conveyors.

A red-hot, 2000-pound bar coil is transferred from an existing drag-chain conveyor to the automatic trolley conveyor loader by a single arm coil pusher. The coil pusher deposits the coil on a drop table which, when lowered, leaves the coil hanging on one arm of a turn and lift mechanism. As this machine revolves 180 degrees it lifts the coil into position to be engaged by a trolley conveyor hook and, at the same time, lowers its other arm to receive the next coil. After cooling on the existing trolley conveyor, a downender removes the coil and sets it on a slider bed on which it is indexed into a banding position. The coil is then transferred onto an existing ox-horn conveyor. *The entire system operates on a 15-second cycle and is completely automatic.*

This automatic coil handling system is more evidence of Planet's versatility . . . its ability to engineer, manufacture, and erect automated systems which solve the most perplexing production, materials handling, and automation problems. Planet has automated production lines, built bulk and unit materials handling systems, designed and erected complete plants . . . and Planet systems are found in the plants of leading manufacturers in almost every industrial classification.

Write or phone to have a Planet engineer demonstration how "PV" can help you . . . you'll find *it pays to plan with Planet.*

912

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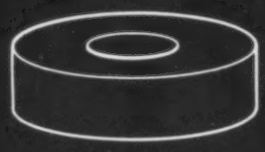
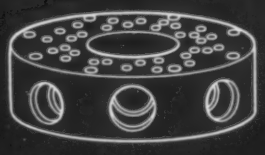
170 OPERATIONS

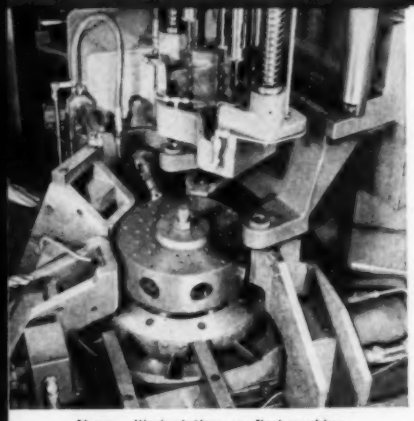
73 HOLES

starting from solid

- DRILL
- REAM
- BORE
- COUNTER-BORE
- GROOVE
- TAP

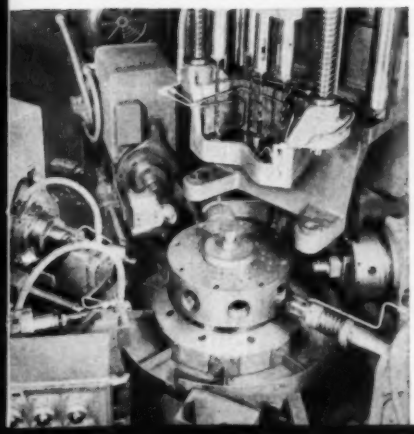






Above — Work stations on first machine (shown in large photo)

Below — Work stations on second machine



## Two 6-station Model S Bore-Matics

# UP PRODUCTION 519%

This cast-iron hydraulic motor body used to be produced on three different machines, with a total production time of 286 minutes per part. Now it is done on two 6-station Model S Bore-Matics in *46 minutes!*

Each machine is equipped with Heald Red Head Borizers to rotate and feed the tooling, and a rotary indexing workholding fixture. Once the part is loaded, all operations are performed in sequence in a fully automatic cycle. After operations on the first machine are completed, the work is turned over and put on the second machine where the remaining operations are finished from the opposite face.

This job demonstrates the unusual versatility of Heald Borizer units—and their ability to handle heavy stock removal while maintaining required accuracy for each of numerous sequential operations. For complete details on this particular application, send for a copy of the April 1960 issue of the "Heald Herald."

MMT-PE

*It PAYS to come to Heald*

**THE HEALD MACHINE COMPANY**

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

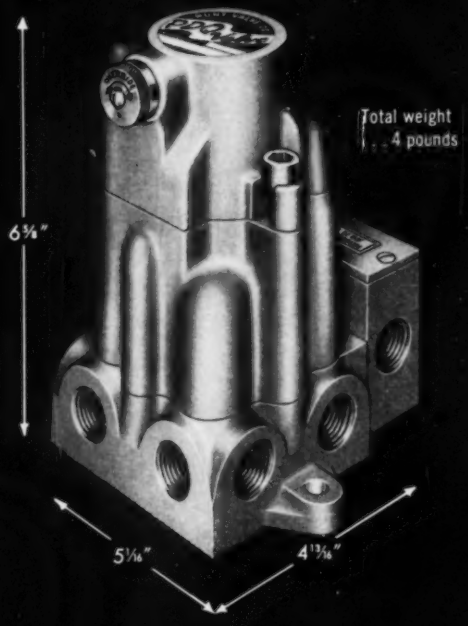
HEALD

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

*Circle 654 on Page 19*

# THE HUNT PDQ

## has Faster Response Time and Greater Capacity than Air Valves – *4 Times Its Weight and Twice Its Size!*




### You asked for a light, compact valve

Here is a full 1/2" air valve at **4 pounds.** It will flow 335 c.f.m. with 100 p.s.i.g. initial pressure to atmosphere. It measures 6-1/2" high by 5-1/16" wide by 4-13/16" deep.

### You asked for speed and capacity

Here is what the Hunt PDQ is capable of. Response time to fill a 140 cubic inch vessel to 90 p.s.i.g. with an initial pressure source of 100 p.s.i.g. is .113 seconds. (6.8 electrical cycles.) To exhaust the same vessel from 90 to 10 p.s.i.g. is .195 seconds. (11.7 electrical cycles.)

The short-stroke pilot actuates a compact, full-orifice poppet-spindle amazingly fast . . . renders traditional air valves obsolete.

The Hunt 1 2" PDQ air valve is designed to do the things you've wanted a valve to do since the advent of automation. Write us today.

N. C. HUNT, PRESIDENT

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☑ Simplicity
- ☑ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ valve tops them all in every class.

Next month . . .
the PRICE and QUALITY story.

**HUNT** HVC ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

JUNE 1960
Vol. 7—No. 6

AUTOMATION®

A PENTON PUBLICATION

*The Magazine of Automatic Manufacturing Operations*

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# automation outlook

### MANUFACTURING ENGINEERING AND RESEARCH

". . . The end result of manufacturing research is manufacturing equipment to carry out the newly developed or advanced methods of manufacture. Today this equipment is almost invariably of automated character, and here again the part played by research and engineering assumes a major role. Manufacturing engineering plays a dual role in development of improved lower-cost production processes and in development of equipment to carry out these processes. . . ."—*R. W. Bolz, publisher-editor,* *see page 56.*

### ECONOMIC FALLACIES

". . . in the United States we have been the victim of certain economic fallacies. The first of these fallacies is that higher wages increase purchasing power and raise the standard of living per se. The simple economic fact is that wages are an element of cost. . . . The result is not an increase in real purchasing power; the result is inflation. The second fallacy is that increases in productivity have been due to labor. . . . increases in productivity, in recent years at least, have been due almost entirely to advances in technology—to the development of machines and equipment that mean greater output per man per hour. . . ."—*A. C. Mattison, president, Mattison Machine Works, and president, National Machine Tool Builders' Association.*

### THE ANCIENT GREEKS TOO

". . . The concept of automation is not new. A Greek translation from 85 BC, referring to a water wheel of that day, philosophizes as follows: 'Cease from grinding, ye women who toil at the mill; sleep late, even if the crowing cocks announce the dawn. For Demeter (Greek Goddess of agriculture) has ordered the nymphs to perform the work of your hands, and they, leaping down on the top of the wheel, turn its axle, which with its revolving spokes, runs the heavy concave Nysarian millstones. We taste again the joys of the primitive life, learning to feast on the products of Demeter without labor.' . . ."—*H. A. Strickland Jr., vice president and general manager, Industrial Electronics Div., General Electric Co.*

### IMPROVED BANKING SERVICES

" . . . The most promising areas of mechanization in banking are reasonably apparent: Reporting functions, loan accounting, deposit accounting and check distribution which, in general, require speed, exhibit repetitive characteristics and involve the volume required to justify mechanization. Contrary to popular misconceptions concerning the leisure hours of bankers, the relatively short public banking day is necessitated by the tremendous volume of clerical work that must be completed before and after the Bank is open to the public. . . . The requirement for tellers, and other public contact personnel, will not decrease. Indeed, if we are to improve and expand our services, the number of people engaged in this work must increase. . . . "—*A. R. Zipf, vice president, Bank of America.*


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BPA NBP




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# ... Fluid Power news

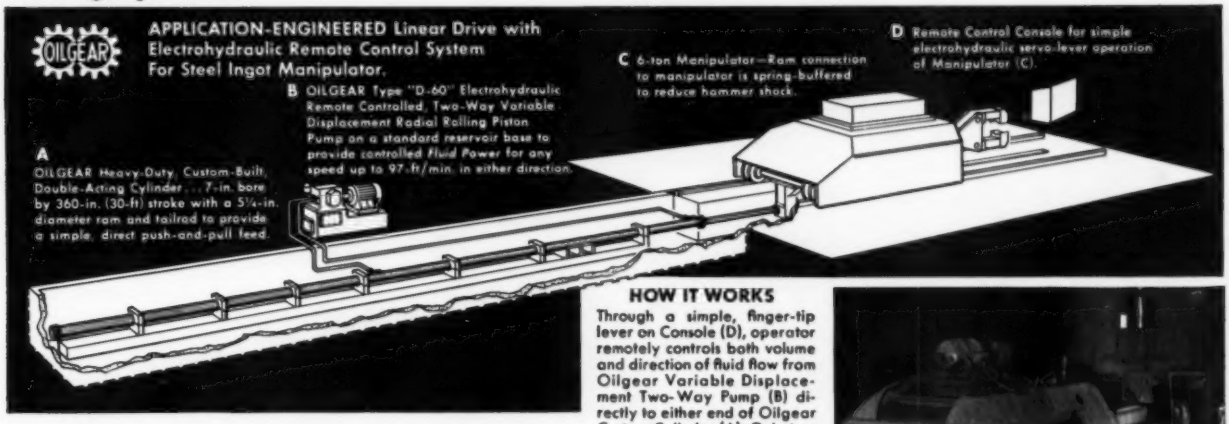
**REPORT NO. 11,801 REMOTE CONTROLLED INGOT MANIPULATOR**

From Oilgear *Application-Engineering* Files

## HOW OILGEAR DRIVE SYSTEM ON INGOT MANIPULATOR IMPROVES CONTROL—CUTS DOWNTIME

**DATA:** Replace an electric variable speed drive on a 6-ton ingot manipulator because of excessive maintenance downtime, high rebuilding and replacement costs. Initial replacement plans called for a hydraulic variable speed drive directly to manipulator wheels, retaining customary practice of operators riding on manipulator. A job study revealed that while feeding an ingot under the open frame steam hammer, forward motion is momentarily stopped by each hammer impact—frequently bouncing manipulator wheels in the air, causing traction, speed control, shock, and operator fatigue problems.

**Basic Manipulator Drive Requirements were re-evaluated as follows: 1.** Remove drive from manipulator to reduce shock-provoked maintenance downtime. **2.** Drive to be independent of wheel traction to improve feed and control. **3.** Provide stepless, remote speed control from zero to maximum in both directions. **4.** Withstand severe shock, vibration, heat, and dust on a continuous 16-hour day basis. **5.** Reduce operating, maintenance, and installation costs. **6.** Provide for future incorporation of hammer control with remote manipulator console.


OILGEAR
APPLICATION-ENGINEERED Linear Drive with Electrohydraulic Remote Control System For Steel Ingot Manipulator.
A OILGEAR Heavy-Duty, Custom-Built, Double-Acting Cylinder . . . 7-in. bore by 360-in. (30-ft) stroke with a 5¼-in. diameter ram and tailrod to provide a simple, direct push-and-pull feed.
B OILGEAR Type "D-60" Electrohydraulic Remote Controlled, Two-Way Variable Displacement Radial Rolling Piston Pump on a standard reservoir base to provide controlled Fluid Power for any speed up to 97-ft/min. in either direction.
C 6-ton Manipulator—Ram connection to manipulator is spring-buffered to reduce hammer shock.
D Remote Control Console for simple electrohydraulic servo-lever operation of Manipulator (C).

**HOW IT WORKS**

Through a simple, finger-tip lever on Console (D), operator remotely controls both volume and direction of fluid flow from Oilgear Variable Displacement Two-Way Pump (B) directly to either end of Oilgear Custom Cylinder (A). Only two pipe lines are required. Power input is used only in proportion to work performed, as no pump output power is wasted in direction control valves, external relief valves, flow control valves, auxiliary components, or excessive piping. Stepless, infinitely variable, smooth, steady manipulator speeds are instantly available in either direction. Fluid flow and pressure decelerate to zero as flow direction is changed—flow and pressure then accelerate to any selected amount in the new direction . . . reversal is smooth-cushioned — shock is eliminated. Controlled acceleration and deceleration; hydrodynamic braking; automatic pressure and flood lubrication; continuous filtration of power fluid . . . all are inherent features of Oilgear "Any-Speed" Drive Systems.

Hammer operator indicated Oilgear-powered Manipulator with 5300-lb ingot.

Manipulator operator indicated. Cut-off of second 9-in. square, 90-in. bloom worked from one ingot.

**SOLUTION:** An Oilgear Linear Drive and Electrohydraulic Control System as shown above schematically. This departure from customary manipulator drives has proved—*in over two years of operation*—to have the following advantages: **1.** Lower operating costs . . . previous manipulator averaged 12% to 15% downtime every 16-hour day for repair and adjustment of drive and control components. **2.** Direct push and pull linear drive is a more positive, smoother, shockless feed—NOT affected by variations in wheel traction. **3.** Remote console with simple electrohydraulic servo control eliminates operator discomfort and fatigue. **4.** Cylinder is protected below floor—"Power-Pak" is mounted away from heat and dust of work area. **5.** Constant, automatic overload protection insures longer life, prevents damage.

System was selected due to Oilgear's reputation for trouble-free reliability, long life, simplicity, and on-the-job-proved performance of the following *Oilgear-Powered* equipment in this user's plants . . . 300-ton ingot strippers . . . large forming presses . . . tube pointing presses . . . hydrostatic testers . . . stripping presses . . . pipe benders . . . seamless steel tube piercers . . . planers . . . cut-off machines . . . tube threaders—operating efficiently—in constant, daily use—some have been in service for more than 20 years.

**User Reports**—" . . . well pleased with the steady feed rate at both low and high speeds . . . we'll go to this type of drive when we rebuild or require another Manipulator."

**For accurately controlled linear or rotary power—for the lowest cost per year . . . check with Oilgear!**

*For practical solutions to YOUR linear or rotary Controlled Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . . . .*


**THE OILGEAR COMPANY**

*Application-Engineered Controlled Motion Systems*

**1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN**

**Phone: Mitchell 5-6715 . . . Direct Distance Dialing Code 414**

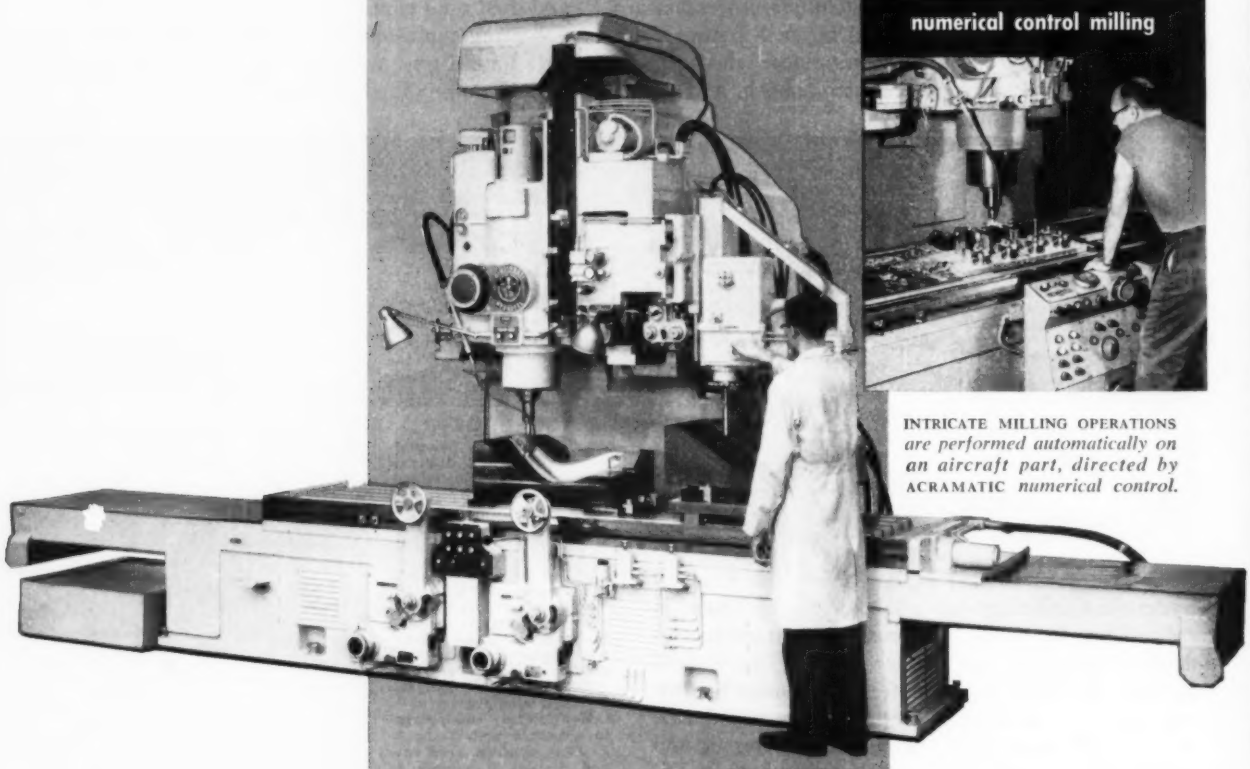
*Here's what the...*

**CINCINNATI**

numerical control milling



INTRICATE MILLING OPERATIONS *are performed automatically on an aircraft part, directed by* ACRAMATIC *numerical control.*



CINCINNATI *30" x 96" Vertical Hydro-Tel Milling Machine, equipped with combination automatic depth control and 360° profile milling, machining an automobile arm rest die.*

CINCINNATI

**CINCINNATI®**

MILLING MACHINE DIVISION

BUILDERS OF FINE MACHINE TOOLS: KNEE TYPE AND BED TYPE

20 years.

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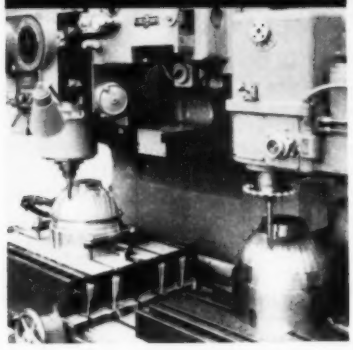
# HYDRO-TEL

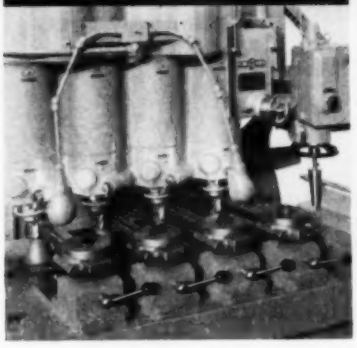
## *can do automatically in your shop...*

360° automatic profile milling



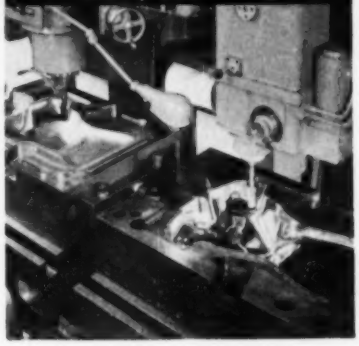
PROFILE OF THE MASTER *(at right) is accurately duplicated on the workpiece—a punch which forms street light shields.*

multiple spindle milling



PRODUCTION IS QUADRUPLED *on this 28" Vertical Hydro-Tel, as contours of four connecting rods are simultaneously profile milled.*

combination depth control and 360° profile milling



COMBINATION TRACING *of a life-size dress form mold on a 28" Hydro-Tel. This complex part is completed in a single setup.*

Their versatility is exceptional. CINCINNATI Hydro-Tels can perform any of several machining operations. And they do each job with speed and accuracy . . . milling up, down and around *automatically*.

Equipped with standard tracing units, Hydro-Tels meet the highest requirements of die sinking and production shops. Automatic depth control tracing, 360° automatic profiling, and combinations of these two methods provide accurate reproduction of the most complex shapes. And multiple spindle heads are available to suit your particular machining operations and production schedules.

Or the Hydro-Tels may be equipped with ACRAMATIC Control, the simplified numerical control system completely designed, engineered and built *by* CINCINNATI *for* CINCINNATI Machines. ACRAMATIC lowers the costs of both programming and machining . . . through contour programming, for example, which requires less input data because of exclusive parabolic interpolation method.

Our Field Engineers will be glad to tell you more about versatile Hydro-Tels. Or write for Catalogs M-1773-3 and M-1923-2; for data on ACRAMATIC Numerical Control, specify Publication M-2125.

MMT-PE

Booth No. 1034

MILLING MACHINES • DIE SINKING MACHINES • CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO



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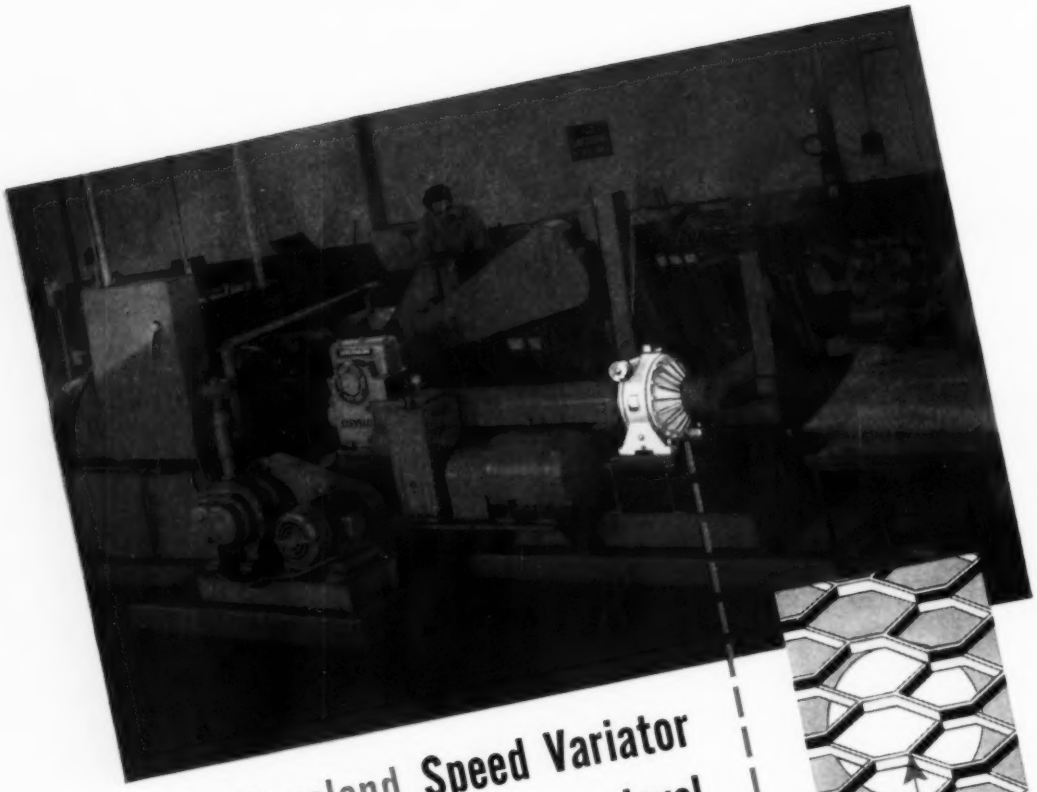


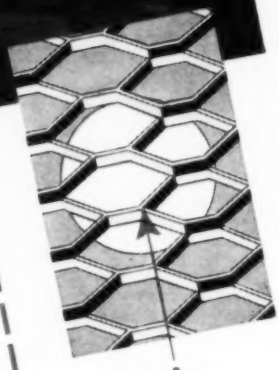
# a *rugged* Cleveland Speed Variator keeps Steel Lath quality at top level

Playing an important role in the production of perforated metal lath is a heavy-duty Cleveland Speed Variator. This novel lathing "keys for keeps" because applied plaster is automatically guided into a positive locked-in position by the precise twist * engineered into the work.

Driving the lath machine's leveller is the job assigned to the Speed Variator. It's a mighty important function because leveller speed has to be in absolute synchronization with expander speed. If not, lath will buckle or expand too much. Then lath is rejected—profits drop.

With their Cleveland Speed Variator, the lath producer is able to maintain set speeds—without *any* variance. Changing speeds, if desired, is merely a simple twist-of-the-wrist.

Wherever there's a need for industrial speed variation—there's a Cleveland to handle the job smoother, quieter, more efficiently. Write for your free copy of Variator Bulletin K-200—it gives the complete engineering story.



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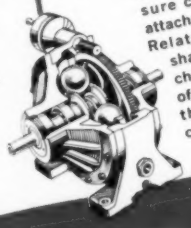

**HOW IT WORKS**

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view.)

**Cleveland Worm & Gear Division**
Eaton Manufacturing Company
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CLEVELAND SPEED VARIATOR



Circle 658 on Page 19

# AUTOMATION news

Today's events and developments in the field of automation

## Special Machine Sparks Plantwide Automation Program

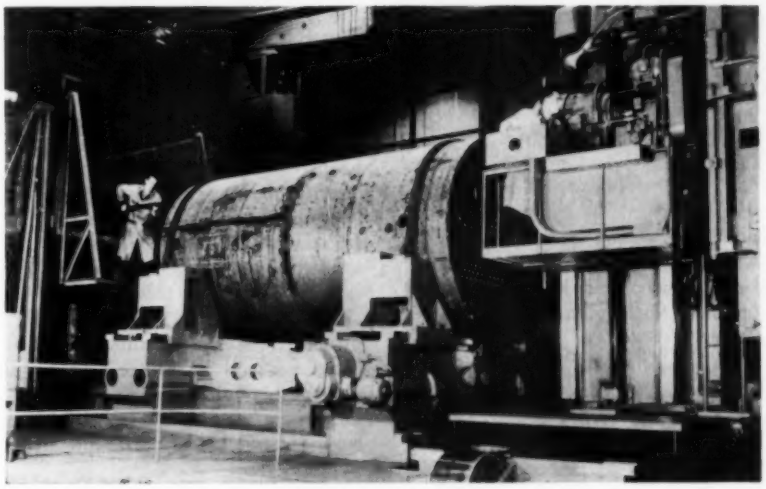
SUCCESS in its first serious venture into automatic operations—through the acquisition of a $300,000 special machine—led Cleaver-Brooks Co. to initiate a complete automation program for the manufacture of packaged fire-tube boilers at its manufacturing center in Lebanon, Pa. As a result of the automation program, which cost a total of $800,000, boiler production has been tripled and fabricating costs have been cut substantially. Work scheduling has also been simplified, and lead times (formerly as long as two years) have been shortened considerably.

The machine that prompted a re-examination of the entire boilermaking process was the idea of **John Cleaver**, president of the firm. Development was carried out in conjunction with Ingersoll Milling Machine Co.

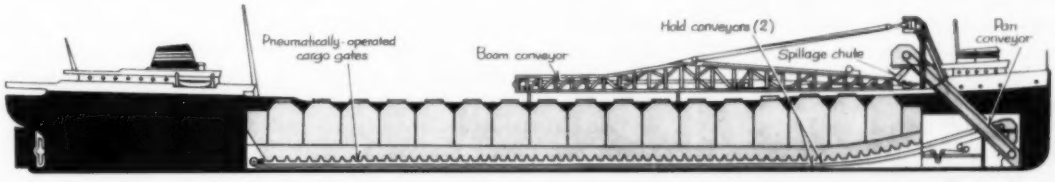
In operation, a semifinished boiler is clamped to a fixture in the center of the machine. A workhead (at right in photo) is then guided automatically to preset locations where holes are trepanned and chamfered in the flue sheet at one end of the boiler. Positioning and cycling of the workhead are controlled by photoelectric cells that scan a master layout chart consisting of black dots on a white background.

When the first flue sheet has been processed, the entire boiler is lifted, hydraulically, rotated 180 degrees, lowered, and locked into position. The machine then trepans and chamfers holes in the second flue sheet.

Following this operation, flues are inserted in the holes from the other end of the machine. An ele-



MULTIPURPOSE machine prepares holes in the flue sheets at ends of boilers and sets inserted flues in place by flaring and beading. Operation of workhead, right, is controlled by photoelectric cells that scan a master layout template corresponding to a desired hole pattern. Inserter operator at left can control height of an elevator carrying a supply of flues. Hydraulic jack permits lifting and rotating boiler in fixture to place other flue sheet in position for machining.




SELF-UNLOADER boat, named *S.S. Adam E. Cornelius*, is the largest and most modern freighter operated on the Great Lakes by American Steamship Co. The ship is used primarily to haul coal and limestone in multiple holds that have an aggregate capacity of 20,000 short tons of coal. The self-unloading equipment, designed and built by Hewitt-Robins Inc., includes two 4-foot wide and 482-foot long hold conveyors located beneath the ship's 142 air-operated cargo gates. Material from the conveyors is discharged to a pan conveyor that lifts the material and places it on a 6-foot wide boom conveyor. The boom conveyor, operating at a belt speed of 520 fpm, discharges coal at an average rate of 3100 tons per hour onto the ground or to dockside material handling equipment. Pushbutton stations located at strategic points on the ship facilitate efficient unloading operations.

**AUTOMATION NEWS**

vator carrying a supply of flues can be adjusted to various heights to facilitate the insertion process.

With the boiler in the same position, the workhead is next actuated to perform a flaring and beading operation that sets the flues in one flue sheet. The boiler is then repositioned and the same operation performed on the other flue sheet. This completes the work cycle of the machine, which can handle any size boiler from 50 to 600 horsepower.

In commenting on the over-all boilermaking automation program, Cleaver said that twenty precision workstations had been provided at various points in the process. He added that the same techniques, with additional refinements, have been incorporated in a new manufacturing facility in Stratford, Ont., Canada.

## Data Processing System To Move On Wheels

MOBILE data processing system has been designed for a leading petroleum producer by Hagan Chemicals & Controls Inc. to provide rapid monitoring of operating conditions during plant start-ups.

Housed in a special trailer, a Kybernetes 2000 data processing system will be transported to sites of new petroleum, petrochemical, and chemical processing plants so that engineers can readily check on initial performance. Subsequently, the equipment will be used for periodic data processing needs throughout the producer's plant.

The trailer will carry its own power supplies, thus permitting input data to be fed directly into the data processing system from appropriate transducers within the process. In addition to logging flows, liquid levels, temperatures, pressures, and other functions, the 100-point data system will continuously scan all points for off-normal or out-of-limit conditions.

Process engineers will also use the system for dynamic analyses in which selected points will be scanned at the rate of four points a second. The scanned data will then be transferred to punched tape for subsequent examination.

## AUTOMATION's Roger W. Bolz Appointed Publisher-Editor

CONTINUED growth in the technology of industrial automation has been reflected in both the scope and depth of coverage accorded the subject in AUTOMATION magazine. In recognition of the increased responsibility and need for co-ordination of effort that this trend necessitates, **Roger W. Bolz** has been promoted to the position of Publisher as well as Editor.

Publisher-Editor Bolz is well-known in industry as a professional engineer and writer. His industrial experience, and research in design for production, led to his authorship of a complete work on the design of products for manufacture. This work, in two volumes entitled *Production Processes-Their Influence on Design*, has brought him industry-wide recognition as an authority. Mr. Bolz has also contributed to the ASME Handbook, Plant Engineering Handbook, and Kent's Mechanical Engineering Handbook.

A registered professional engineer (Ohio) with engineering education acquired at Case Institute of Technology, Mr. Bolz brought to the Penton Publishing Co. a wealth of production and design experience in aircraft, shipbuilding, electric motors, general products, machinery, machine tools, and processing equipment. Other experience in materials handling and processing plant layout has been augmented by service as a works engineer in charge of machine design and development, and plant maintenance, for a large concern.

Mr. Bolz is a member of the Manufacturing Engineering Council, American Society of Mechanical

## The Machine Tool Exposition—1960

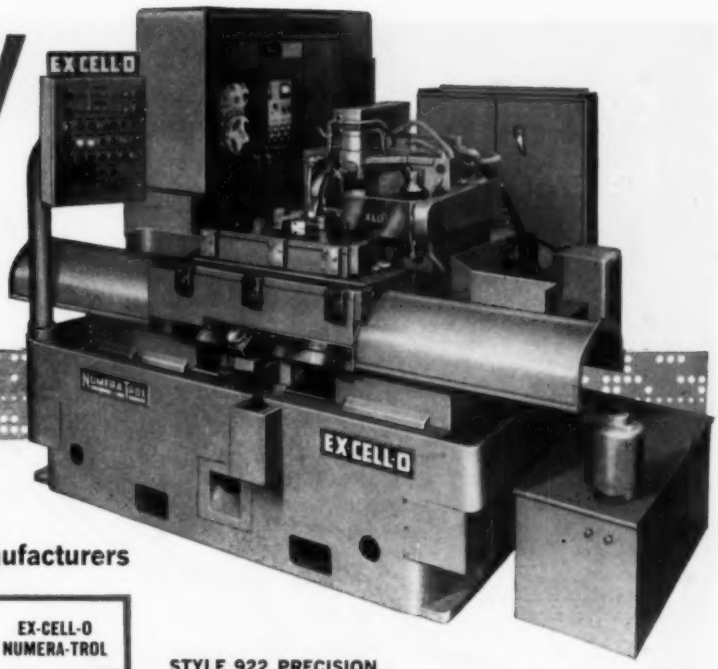
MORE than 125,000 production executives from all over the world are expected to attend The Machine Tool Exposition—1960, to be held at the International Amphitheatre in Chicago next Sept. 6-16. This once-in-five-years event, sponsored by the National Machine Tool Builders' Association, will offer an unprecedented opportunity for top industry executives, plant managers, engineers, and others concerned with production to view the latest in U. S. machine tool technology.

Of the more than 1000 major machines that will be shown, many have been designed and built specifically for introduction at this event. Most of the equipment will be in actual operation. Prominently featured at the Exposition will be exhibits of numerical control systems.

Running concurrently with The Machine Tool Exposition—1960 will be the Production Engineering Show. Occupying both wings of the Navy Pier in Chicago, the Production Engineering Show will be devoted to exhibits of mechanisms, instruments, and other equipment that can contribute to production efficiency. Included in the latter category are machine components, controls, gaging and testing devices, materials handling equipment, welding and riveting machines, grinders, heat treating apparatus, and finishing equipment.

Registration at either The Machine Tool Exposition—1960 or the Production Engineering Show, and payment of a $3 fee, will admit visitors to both events. Special buses will be available to take visitors nonstop from one show to another at planned, regular intervals.

# a study in time




## How Ex-Cell-O Numera-Trol Cuts Costs for Three Modern Manufacturers

| Part: TEMPLETS | CONVENTIONAL METHODS | EX-CELL-O NUMERA-TROL |
|---|---|---|
| Lead time | 128 hrs. | 16 hrs. |
| Grinding per/piece | 60 hrs. | 6 hrs. |
| TIME SAVED | 166 HOURS | |

| Part: FUEL CONTROL CAMS | CONVENTIONAL METHODS | EX-CELL-O NUMERA-TROL |
|---|---|---|
| Lead time | 150 hrs. | 40 hrs. |
| Machining per/piece | 80 hrs. | 7.5 hrs. |
| TIME SAVED | 182.5 HOURS | |

| Part: STEAM TURBINE BUCKETS | CONVENTIONAL METHODS | EX-CELL-O NUMERA-TROL |
|---|---|---|
| Lead time | 144 hrs. | 24 hrs. |
| Machining per/piece | 90 hrs. | 12 hrs. |
| TIME SAVED | 198 HOURS | |

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Slides are controllable to .000025". Grinding unit is interchangeable with boring and turning unit.

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Slashes lead time in producing drum-type cams.

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Performs intricate and accurate milling and grinding of 3-dimensional forms.

Are you faced with tough prototypes or production parts that "can't" be produced economically? See your Ex-Cell-O Representative, or write direct for details on how you can apply Ex-Cell-O's Numera-Trol system of tape-controlled precision machine tools to do more jobs, faster and more accurately!

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Circle 659 on Page 19

**With Extras . . . At No Extra Cost**

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
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5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

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## for longer, more efficient cylinder service

You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space . . . and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities . . . air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.

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RIVETORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS


Circle 660 on Page 19

Engineers, Sigma Delta Chi, Institute of Radio Engineers, American Management Association, Instrument Society of America, American Ordnance Association, and National Society of Professional Engineers. He serves on the Cleveland Ordnance Panel of Machine Tool Consultants and the Board of Governors of the Cleveland Engineering Society, and is second vice president of the latter organization.

Mr. Bolz' new assignment will include policy interest and general responsibility for all phases of the AUTOMATION publishing operation. In announcing the appointment, **Russell C. Jaenke**, president of the Penton Publishing Co., expressed confidence that AUTOMATION's effectiveness in serving the vital needs of its readers in the field of manufacturing engineering for today's markets will continue to grow, and that its outstanding editorial acceptance will advance in keeping with the burgeoning automation of the sixties.

## Punch Cards Control Batching In Grinding Wheel Plant

NEW production plant, costing $6½ million, has been built by Norton Co. to provide additional capacity for the manufacture of organic bonded grinding wheels. The plant, recently unveiled at the company's 75th Anniversary celebration, uses the latest in automatic production equipment and techniques. Principal products are resinoid, rubber, and shellac bonded grinding wheels.

Foremost among the technical innovations is an automatic weighing system built by Heltzel Steel Form & Iron Co. Function of the weighing system is to draw from multiple storage tanks the correct amounts of abrasive grain and bonding material for each batch of wheels, and deliver the ingredients to a mixing area.

In operation of the system, three weighing carriers travel on a closed monorail loop. As a carrier arrives at the beginning of the line, it receives a punched card from a stack of cards placed in a dispenser. The carrier then moves beneath a row of raw material storage tanks.

## DATA PROCESSING TOPICS . . .

EDP SERVICE CENTERS PLANNED—Plans for a nationwide network of data processing centers that will make record keeping automation available to virtually every type and size of business have been announced by National Cash Register Co. The project will enable retail stores, industrial and commercial firms, savings banks, and other companies to obtain detailed analyses of their daily business in less than 24 hours. Three centers will be opened this year. One will be located in New York, another in Los Angeles, and the third at company headquarters in Dayton. The processing centers will use the company's NCR 304 data processing system and will also be equipped with high speed check sorters. Under the new plan, business firms will bring or mail their punched tapes or cards to the centers, which will process them and return the desired reports.

MODULAR INDUSTRIAL CONTROL COMPUTER—Westinghouse Electric Corp. has announced plans to build and market an industrial control computer whose speed, input-output capacity, and memory can be matched to the needs of particular processes by the addition of semistandard "function" modules. Versatility thus provided will qualify the system for use in general industrial and electric utility control applications, with ready modification possible if process conditions change. The basic computer will use static devices exclusively, so that it will be sufficently rugged for use in severe environments such as those found in the chemical, paper, petroleum, and steel industries.

PRODUCTION TECHNIQUES SPEED COMPUTER ASSEMBLY—Correctly wiring thousands of separate leads in the terminal bays of computers and data processing systems is a major production problem. Recently Librascope Div., General Precision Inc., a subsidiary of General Precision Equipment Corp., developed a simplified approach to this problem. By separating the large units into three modules, or panels, a given worker is responsible for fewer connections on more accessible workpieces. Interconnections are rapidly made when the panels are mounted. Another timesaver has been adoption of solderless crimped connections for many circuit applications. At completion of wiring, the bays are tested automatically by equipment which checks all connections in the cabinet for continuity and potential. Over-all lead time reductions up to 25 per cent have been realized with these techniques.

LANGUAGE TRANSLATOR IMPROVES COMPUTER UTILIZATION—Capable of performing time-consuming translation processes, a computer translator system installed at System Development Corp. will free existing large computers for their primary function of making complex calculations. The system, built by Electronic Engineering Corp., facilitates intercommunication between computers or data processing systems that use different media or formats. Five basic translations can be performed: magnetic tape to magnetic tape, magnetic tape to punched paper tape, magnetic tape to punched cards, magnetic tape to line printer, and punched cards to magnetic tape. Primary use of the system will involve translating magnetic tapes from a SAGE Air Defense System computer into a form suitable for input to an IBM 709 computer.

CONTINUOUS PROCESS CONTROL A REALITY—Performance of a computer controlled ammonia plant is up to expectations in initial tests, according to Monsanto Chemical Co. officials. Heart of the control system is an RW-300 computer manufactured by the Ramo-Wooldridge division of Thompson Ramo Wooldridge Inc. By use of the computer, Monsanto expects to achieve maximum productivity from its plant investment at minimum operating cost. The computer achieves this by continually monitoring the process conditions, making numerous calculations, and adjusting the controls automatically for optimum results.

TAPE REPERFORATOR ALSO PRINTS OUT—Simultaneous printing and reperforating are performed by a teletypewriter recently announced by TELautograph Corp. In both sending and receiving messages, the unit prepares a conventional 11/16-inch, five-channel perforated tape. At the same time, it prints a typewritten message between the feed holes of the perforated tape. Tapes produced on the machine are fully compatible with optical or electronic tape readers and are suitable for use with high speed computing and communications equipment. Approximately the size of an electric typewriter, the unit is available with several keyboard options including four-bank configurations. Two models—one for receiving and the other for off-line tape preparation—are available for lease or sale.

**A COORDINATED ELECTRICAL SYSTEM IS THE KEY TO IMPROVING PRODUCTIVITY AND PROFITS**

Westinghouse is ready now to help you plan economical steps to automatic production . . . to achieve your goals without over- or under-automating.

For many manufacturers, Westinghouse *Progressive Automation* has already proved a completely practical method of gaining improved product quality through step-by-step control of operations . . . a long-term plan with minimum capital cost for each step.

**Now . . . automation step by step:** Step-by-step automation can start with the modern Westinghouse controls, motors and drives at work in plants today. Each of these components was developed to achieve an immediate production objective . . . to control a single machine, a conveyor line or an entire installation. With this plan you then add other Westinghouse coordinating controls, all of which are compatible with those previously installed.

**Benefits of long-term planning with minimum investment:** First, you are meeting current production needs . . . improving productivity and/or raising product quality. Second, you are building a coordinated system . . . always ready for the next step in your long-range plan for automation. Your goal may eventually be overall production coordination under one master device . . . the Westinghouse industrial control computer.

Westinghouse—your one source for computers, controls and subsystems, and all equipment such as transformers, switchgear, motors, gearing and drives —will assume complete system responsibility.

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WESTINGHOUSE PROGRESSIVE

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**Examples of Progressive Automation at work:**

**In the primary metals industry,** installations of Westinghouse PRODAC* (programmed digital automatic control) have improved product quality and mill efficiency. This system has made possible automatic control of rolling mill functions, as well as monitoring all phases of the product and process by data accumulation systems.

Westinghouse industrial control computers are now being integrated with PRODAC to transform rolling mill equipment into a completely automatic unit. Three such systems are on order and underway.

**In the paper industry,** PULSETTER*, an automatic digital control system, makes possible new standards of accuracy and product quality in paper production.

**In the chemical processing industries,** Westinghouse provides OPCON* which experiments, then finds and controls optimum production efficiency.

Let us know your objectives. Westinghouse is prepared to work out a long-range plan of progressive automation to provide your plant with the controls and other devices necessary to improve production. We are prepared to recommend, furnish, install . . . and maintain . . . all equipment to fulfill that plan. Call your local Westinghouse representative for complete information on *Progressive Automation*.

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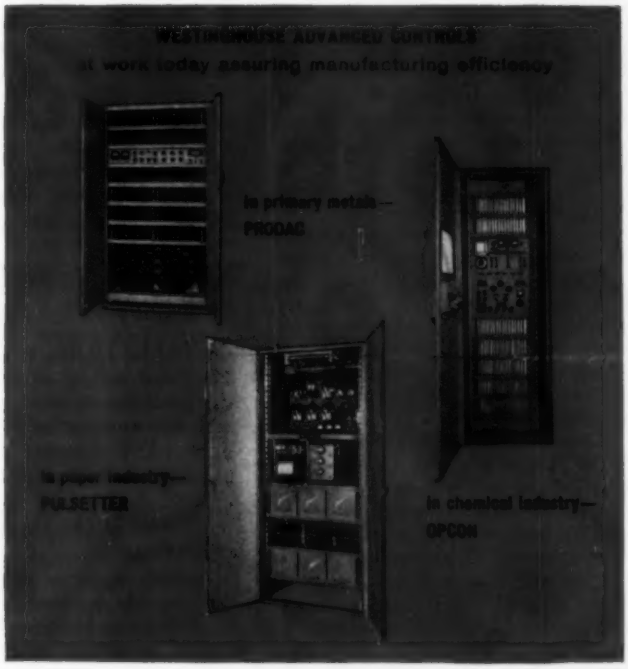


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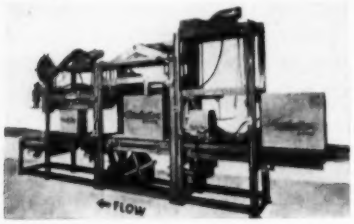
Tune in Westinghouse CBS TV-Radio Coverage, Presidential Conventions, July 10-29.

*(Advertisement)*

## New Automation for Tape Sealing Mixed-Sized Cases

Now in plant operation, this new automaton, a marvel in tape-sealing, automatically tape-seals random-sized shipping containers as they merge to this machine for final sealing.




The advantages of tape sealing are that cases are easiest to open without injury to persons, contents and containers, particularly if it should be desirable to re-use the cases. They are naturally more dust-proof and with an identifying tape, they are more pilfer-proof than the old-fashioned glued or stapled cases. To provide extra customer satisfaction, a tape "rip-cord" applicator attachment can be added to the machine.

This tape "rip-cord" positively enables customers to tear open the tape without injury to persons, contents and shipping cases. New peelable tapes are now becoming available to serve this same long hoped-for purpose. Glued or stapled cases are the old fashioned methods and can be dangerous to both persons and contents. The containers are usually cut or torn apart and nobody gains.

"General's" Automatic tape sealer is a compact machine. The space wasting compression machinery section, required for glue sealing, is eliminated. When the carton leaves the taper it is ready for immediate shipment.

This "General" Automatic Case Sealer Taper (Model TS-30-SS) is built to be self-setting in several progressive stages. It automatically adjusts itself to random size cases, closes the top flaps and tape seals the top and bottom flaps of a filled case. A production case history of this machine in the Paterson, N. J. plant of the Manhattan Shirt Co. can be obtained by writing **General Corrugated Machinery Co., Inc., Palisades Park 9, N. J.**

P.S. "General's" simple semi-automatic Tape-Sealer is a self-measuring Tape - Dispenser - Conveyor for mixed sizes. It is a step toward lower case sealing costs for those who may not yet be ready for fully automatic tape sealing.

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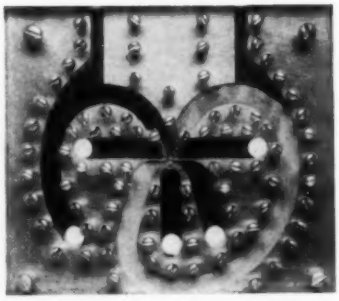


U.S. ARMY photo illustrates simplicity of construction of a fluid control device developed by scientists at Diamond Ordnance Fuze Laboratories and designated a pure fluid amplifier. Having no moving parts, device operates on the principle that a high power fluid stream (entering vertical channel at bottom of unit) can be diverted easily by a low power fluid stream (emitted from the left or righthand horizontal channels). Unit shown is a flip-flop; feedback channels (curved paths leading from vertical output channels at top to separate nozzles at bottom) are provided so that the high power fluid stream will remain diverted to the proper side even though the initiating low power fluid stream is of short duration. Using the principle outlined, a series of amplifiers, computers, logic circuits, and control systems is envisioned. Special features of such devices would be their inherent ruggedness, ability to operate at extremely high temperatures, and low cost of production. Although the speed of response is not as fast as for electronic systems, operation of the device is much faster than for fluid systems with moving parts. Thus, device is suited for many industrial and military applications where signals fall in the audio frequency band. In computer applications, systems using the new control element would be faster than mechanical systems.

Under card control, the carrier stops successively at each tank containing the proper ingredient for a desired mix. At each station, the correct weight of material is automatically added to a hopper on the carrier.

When a batch has been made up, the carrier proceeds to a mixing area where the hopper is transferred to a spur monorail at one of nine mixing positions. The carrier, moving on the main loop, then picks up an empty hopper and returns to the beginning of the line for another punched card.

## Numerically Controlled Units To Employ APT System

INSTALLATION of numerically controlled milling and profiling machines, to be operated in accordance with the Automatically Programmed Tool (APT) system developed at Massachusetts Institute of Technology, is planned by 24 major companies in the aircraft and missile industries.

According to a recent issue of *Keeping Up*, a monthly publication of Television Shares Management Corp., the first installation has been completed at Rocketdyne Div., North American Aviation Inc. The cost of this installation, which includes a Cincinnati Milling Machine Co. milling and profiling machine and two International Business Machines Corp. type 709 computers, is estimated to be $750,000. Rocketdyne expects to make a second installation in the near future.

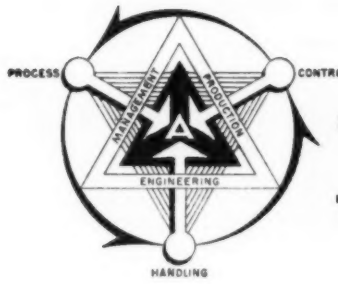
The APT system (see AUTOMATION, April 1959, pp. 9-10) consists of a basic language of commands which provide a simplified system for programming numerically controlled machine tools.

## Aluminum Strip Conductor Standards Established

STRIP-WOUND COILS of aluminum have replaced copper wire coils in many industrial applications. Typical electrical products now using this type of coil construction include lift magnets, welder transformers, automobile horns, dry-type distribution transformers, and solenoids.

One of the advantages of strip-wound coils is that layer-to-layer voltages are reduced from those that exist with conventionally wound coils. This permits the use of much thinner insulation between concentric turns, and often justifies the use of anodized strip wherein the insulation is a film of aluminum oxide only 0.00022 inch thick, bonded to the base metal. The oxide coating is easily applied to the strip on continuous, automatic equipment.

Since strip-wound coils are made in a spiral configuration, the winding equipment employed may be simpler. For example, traversing mechanisms of conventional winders are not needed. Usually, the coils may be wound on forms that




# around the triangle

## SONIC ENERGY BOOSTS CLEANING EFFICIENCY

Production gains of 300 per cent, together with a reduction of cleaning solution cost of 87 per cent, were realized by a major electrical equipment manufacturer when he substituted sonic energy for hand cleaning methods in the processing of rotor assemblies and stator housings. Using a sonic energy cleaning unit developed by the Pioneer-Central Div. of Bendix Aviation Corp., the manufacturer also saved on rework, which formerly amounted to 15 per cent of the products. Replacement of naphtha with an inexpensive water detergent, possible with the new process, eliminated fire hazard and skin irritation problems.

## HEAVY MEDIA PROCESS GETS CLOSED LOOP CONTROLS

Closed loop control of an anthracite coal cleaning process has resulted in substantial savings, according to Underkoffler Coal Service Co. Major benefits resulted from the recovery of low-ash coal previously lost as waste and preparation of coal that has uniform ash content. The control system is a collaborative development of Wilmot Engineering Co.; Brown Instruments Div., Minneapolis-Honeywell Regulator Co.; and Industrial Nucleonics Corp. Equipment includes radiation detectors that measure the specific gravity of a separatory medium (a mixture of water and magnetite) at two points in the process, a circular chart recorder-controller, a valve positioning system, and magnetite and coal feed controls. The system maintains specific gravity of the separatory medium at $1.70 \pm 0.003$ maximum.

## CONTROL UNIT PREVENTS MALFUNCTION DAMAGE

Protection of injection molding equipment from damage by any of several causes is provided by an electronic control unit developed by Wintriss Inc. With the unit, which does not affect a normal molding cycle, clamping pressure cannot be applied to a die unless the die closes properly on the mold. The control unit receives information from two sources—a pressure sensor attached to the die cylinder and a position sensor mounted on the mold. When a malfunction causes the hydraulic pressure in the die cylinder to exceed a preset amount, the control unit automatically stops and reverses the forward motion of the die piston to open the mold. If the mold does not close properly, the position sensor signals the control unit, and clamping pressure will not be applied. Typical malfunctions that will cause control actions are: Die parts misaligned, die pins too tight, lack of lubrication for tie rods or guide ways, and protruding objects lodged in the mold.

## POINTS WAY TO READING MACHINES

An experimental "shape recognizer" devised by Leon D. Harmon, Bell Telephone Laboratories scientist, is expected to point the way toward development of machines that can read. Presently, the device can differentiate between geometric shapes—squares, triangles, pentagons, hexagons, and circles—regardless of size or orientation. In operation, a translucent sheet marked with a particular test shape is placed on a clear plastic table without any specific orientation. Light from an overhead source passes through the translucent sheet and the table, except where the sheet is marked. When an *Identify* button on the machine is pressed, a photoelectric scanning system is actuated that examines the light pattern under the table. In scanning, 32 rods with photocells on their ends are caused to move simultaneously outward on radial paths. Each photocell crosses a boundary of the marked shape at a particular time. Differences in crossing times of the various photocells furnish a key to the shape, and logic circuits cause a corresponding light pattern to flash on a screen.

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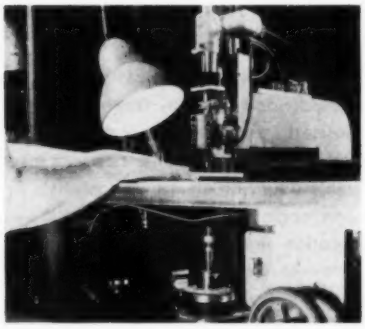
have no flanges to restrain the coil turns laterally.

To meet industry requirements for strip material information, a series of specification, availability, and descriptive data sheets for aluminum electrical strip conductor have been prepared by Reynolds Metals Co. Chemical composition limits, electrical properties, and size tolerances are given for bare strip conductor. For anodized strip conductor, additional information is available covering insulation test procedures. A coil winding facility is also maintained by Reynolds for the fabrication of prototype coils and small lots of coils on a permanent or interim production basis.

## West Coast Firm Enters Special Machine Market

SUBSIDIARY of Rheem Mfg. Co., named Rhebo Corp., has been formed to design and build automatic machines for electronics and other industries that fabricate and assemble small, precision parts. President and general manager of the Mountain View, Calif., firm is **Dr. Richard S. Bower.**

According to Bower, "Automation has become increasingly important in manufacturing transistors, diodes, and other semiconductors to keep down costs and to



DRILLING of multiple holes in stacks of circuit boards is facilitated by a special setup at Librascope Div., General Precision Inc. In use, an operator stacks five circuit boards on locating pins in a fixture. He then places a predrilled plate, containing the desired hole pattern, on top of the stack. The fixture is then positioned under a stylus so that the stylus lowers sequentially into each hole in the plate. As the stylus enters a hole, the operator activates a switch that raises a drill vertically on a rotating spindle beneath the worktable. The drill penetrates the five circuit boards, enters a blind hole in the stylus, and retracts.

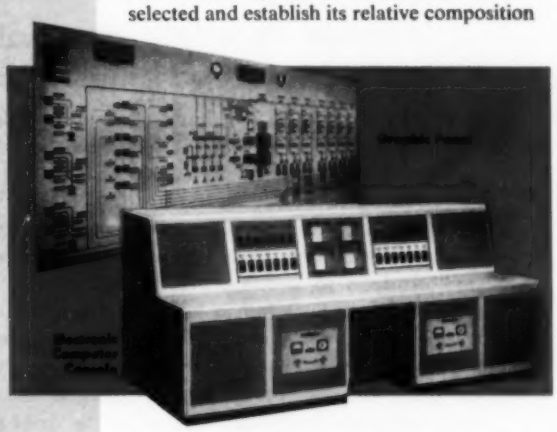

POSITIVE CONTROL OF MATERIALS IN MOTION B-I-F METERS FEEDERS CONTROLS

NEW

**B-I-F ELECTRONIC LEADING-ELEMENT SYSTEM CONTROLS FEEDING AND BLENDING PROCESSES**

B-I-F exclusive leading-element system controls any number of gravimetric or volumetric liquid or solids feeders selected from B-I-F's extensive, compatible line. Control system accepts analog signals, provides for automatic data logging. Result: precise proportioning that means quality control at lowest cost.

**NEW CONCEPT** . . . Electronic circuitry regulates multivibrator elements which emit pulse trains with frequencies corresponding to volumetric or gravimetric feed rates of liquids or solids. High stability solid state components are used throughout. Computer modules permit a component to be selected and establish its relative composition



in the blend total by direct digital setting of volume or weight percentage. System completely monitored and fail-safe.

**B-I-F BUILDS SYSTEMS DEPENDABILITY COMPONENT BY COMPONENT** . . . B-I-F is the only company which can furnish all the basic components and make them function in terms of your process. Our engineering systems group can make a "complete" package of your installation. We invite inquiries.

B-I-F Industries

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

See B-I-F product line in Chemical Engineering Catalog or Sweet's Plant Engineering File . . . or for complete details, write **B-I-F Industries, Inc., 527 Harris Avenue, Providence 1, Rhode Island.**

Circle 663 on Page 19

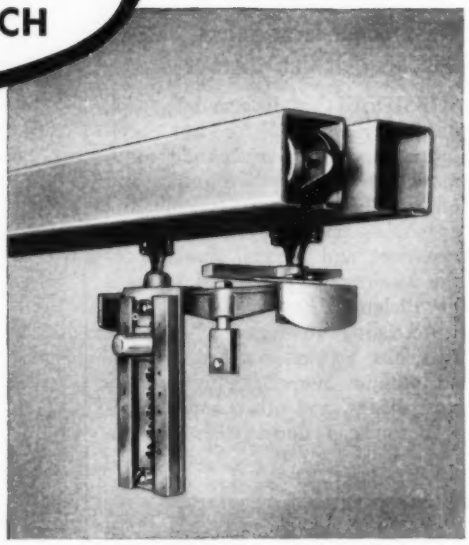
# There's an R-W Overhead Conveyor System to meet your exact requirements

## R-W TWIN-TRAK
TRADEMARK

## OVERHEAD AUTOMATIC DISPATCH SYSTEMS

### . . . provide complete automation in the handling of materials

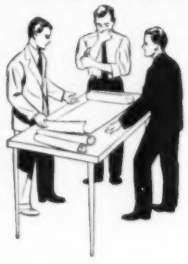
R-W "TWIN-TRAK" Overhead Automatic Dispatch Systems provide a unique and modern method of automatically, economically and efficiently handling materials on a plant wide basis. "TWIN-TRAK" Systems not only move products from one work point to another, but automatically convey parts, components, and products to predetermined work stations from storage banks installed in the free overhead areas under the building trusses. Economical to purchase, install and maintain . . . custom engineered from standard components to offer a specific answer to your materials handling problem at the *right* price. Applicable for plant wide systems or smaller specialized conveying . . . may be altered, expanded or relocated at a later date with 100% reusability. "TWIN-TRAK" Systems not only reduce operating costs and increase materials handling efficiency but also permit the coordinated use of new production techniques and equipment to produce products faster and more economically. Write today for your free copy of "TWIN-TRAK" CATALOG No. F-192.



R-W "TWIN-TRAK" Systems consist of one or more power tracks and as many free or storage tracks as desired, plus switches, carriers and power equipment. Switches and carriers are available with manual or electronic controls . . . all have been engineered to provide positive, reliable operation in a minimum space. New gravity treatments permit absolute control of carriers on gravity feed lines.

**You are cordially invited to visit us in Booth 311 at the Materials Handling Institute's New England Show, Boston, Mass., June 6, 7 and 8.**

### COMPLETE ENGINEERING SERVICE

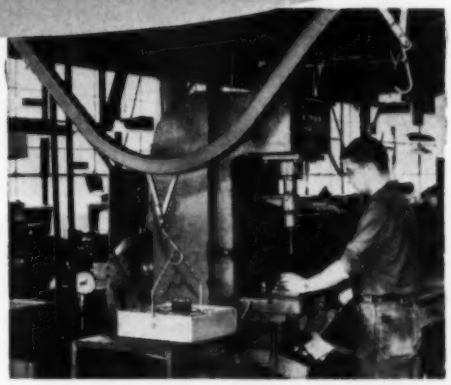


Your local R-W Sales Engineer is a materials handling specialist. He is ready and willing to illustrate how a specific R-W Overhead Conveying System will help you realize maximum production efficiency and economy. If you are planning a new plant, remodeling present facilities or just want to increase materials handling efficiency, he will be glad to survey your plans or facilities and submit a recommended solution.

# R-W "Zig-Zag"®

## CONTINUOUS POWER CONVEYORS

## . . . the most efficient, flexible and economical conveyor of its type



R-W "Zig-Zag" Conveyors offer a time proven method of handling materials faster and more economically . . . equally adaptable for the conveying of electronic devices that require gentle handling to wearing apparel, foods and rugged industrial products. Ideal for either small, special-purpose conveyors or large plant wide systems.

### FEATURES

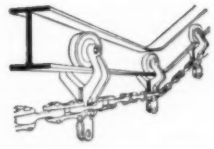
• FLEXIBLE . . . may be installed to move up, down, in, out and around. Ideal for all types of overhead materials handling . . . no matter how large or how small. Efficiently conveys unit loads up to 125 lbs. at speeds of one inch to 100 feet per minute. The only conveyor offering a multiple-drive arrangement with proven drive coordination.

• Rugged . . . consists of a continuous chain of alternate horizontal and vertical wheel units which travels through a rugged steel track . . . flows like water through a pipe. Chain, track, power units and accessories are all "designed for each other" to provide years of dependable service and trouble-free operation.

• RE-USABLE . . . "ZIG-ZAG" Systems may be changed, expanded or relocated with 100% reusability. Economical to purchase and install . . . can easily be "self-assembled" by plant personnel. Meets your needs now and for years to come.

• STOCKED . . . in most metropolitan areas. When necessary, a complete "Zig-Zag" System can be installed and operating in a matter of days. Write for your free copy of the "Zig-Zag" Catalog No. A-93R.

### R-W "458"
CHAIN CONVEYORS

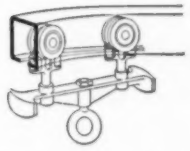


Ideal for conveying light to heavy loads and "tow-cart" installations. R-W "458" Conveyors are easy and economical to operate and maintain . . . may be added on to existing systems. R-W "458" Trolleys offer many exclusive and important features. Write for Catalog No. A-570.

### R-W "460"
LIGHTWEIGHT CONTINUOUS POWER CONVEYORS

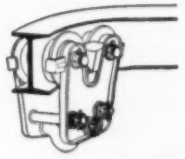
A simple lightweight and extremely flexible conveyor specifically designed for loads of up to 17 lbs. per lineal foot. Available in 200-foot maximum lengths with a maximum 200-lb. draw bar pull. Speed variations of 3 to 30 feet per minute. Does not require special installation engineering . . . quickly and easily installed. Write for Catalog No. A-96-R.

### R-W "SAFE-RAIL"
MANUAL TRACK SYSTEMS



R-W "SAFE-RAIL" Manual track systems are designed and manufactured as a supplement to the "ZIG-ZAG" Power System and provide the ideal system for the majority of hand push conveyor applications available with a complete line of curves, brackets and drop fittings. Engineered for capacities up to 1000 lbs. Write for Catalog No. A-94R-2.

### R-W "TRU-TRED"
MONORAIL TRACK SYSTEMS



R-W "TRU-TRED" Monorail track systems consist of a scientifically designed track section, rolled to exacting specifications, standardized switches, turntables and accessories of all types and sizes. R-W Flexible Ball Bearing Swivel Trolleys are designed and built to meet the demands of modern materials handling. Write for Catalog No. A-64.

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*years of progress through quality products and unexcelled service*

**R W**

**Richards-Wilcox**

**MANUFACTURING COMPANY**

MATERIALS HANDLING DIVISION

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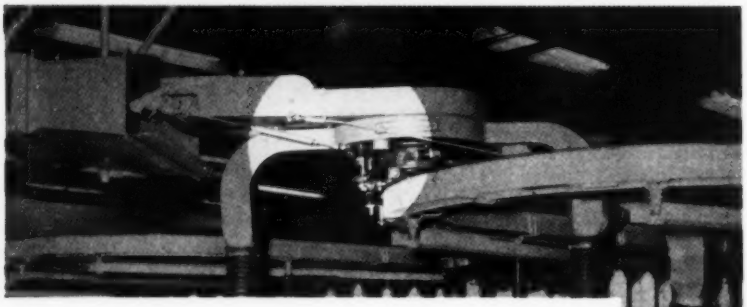
Circle 664 on Page 19

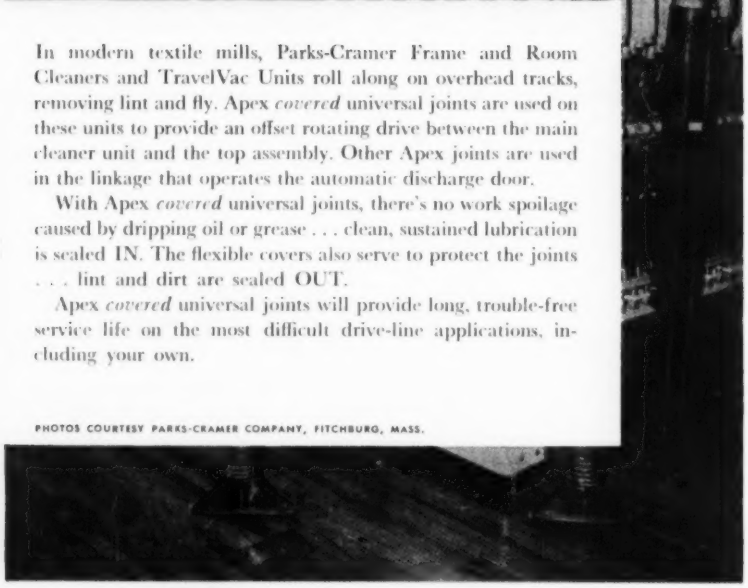


In modern textile mills, Parks-Cramer Frame and Room Cleaners and TravelVac Units roll along on overhead tracks, removing lint and fly. Apex *covered* universal joints are used on these units to provide an offset rotating drive between the main cleaner unit and the top assembly. Other Apex joints are used in the linkage that operates the automatic discharge door.

With Apex *covered* universal joints, there's no work spoilage caused by dripping oil or grease . . . clean, sustained lubrication is sealed IN. The flexible covers also serve to protect the joints . . . lint and dirt are sealed OUT.

Apex *covered* universal joints will provide long, trouble-free service life on the most difficult drive-line applications, including your own.

PHOTOS COURTESY PARKS-CRAMER COMPANY, FITCHBURG, MASS.

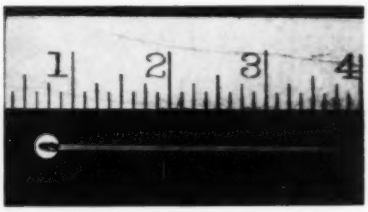


SEE OUR CATALOG IN SWEET'S

or write, on your company letterhead please, for Catalog 28 and Data Sheet.

THE APEX MACHINE & TOOL CO.
1038 South Patterson Blvd.
DAYTON 2, OHIO

Phantom view of Apex universal joint with lubricant-retaining cover, an exclusive Apex development. Apex covered joints operate efficiently in wet, dry, corrosive or abrasive atmospheres and




SURFACE temperature probe developed by Fenwal Electronics Inc. features fast response in the temperature range of 0-350F. Thermistor-type unit can be cemented, taped, potted, or clamped to any surface.

maintain and improve product quality."

Rhebo Corp. is presently engaged in automation projects for several electronics firms in the San Francisco Peninsula area, including Rheem Semiconductor Corp., another Rheem Mfg. Co. subsidiary.

## British Firm Acquires Rights To U. S. Warehousing System

RECENTLY formed British firm, named Solartron-John Brown Automation Ltd., has acquired complete exploitation rights for the Gumpertz automatic warehousing system in all countries outside America. The new company is owned jointly by Solartron Electronic Group Ltd. and John Brown & Co. Ltd., and will promote use of the system in manufacturing, distribution, and consumer warehousing operations.

The system, invented by Donald Gumpertz, has been in full-time operation in a U. S. pharmaceutical distribution plant for two years. According to the new firm, it is believed ideally suited for use in supermarkets.

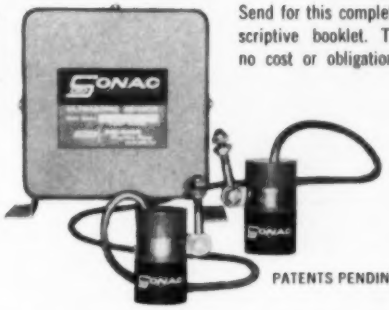
In such an application, a shopper will pick up a blank card upon entering a sales area. In this area, the shopper examines sample products placed on display, which may be handled. On deciding to purchase, the shopper places the card in a slot where the name and size, or weight, of the product are printed. Multiple quantities may be ordered by inserting the card more than once in the slot, and deletions may be made by crossing out unwanted items.

Completed cards are then placed in an electronic reader that totals the bill and displays the total amount. When a cashier has been

A NEW, ULTRA-SONIC, NON-CONTACT SENSING AND SWITCHING SYSTEM

SONAC

Here truly is a new dimension in automated controls! Delavan's new SONAC uses ultrasonic energy for its "beam". This new concept offers many advantages over available sensing devices. SONAC has no lamps to burn out . . . nothing to replace . . . eliminates down time. SONAC is unaffected by vibration, dust, industrial contamination or ambient light. SONAC will sense ferrous and non-ferrous metals, liquids or solids, transparent or opaque materials, yet requires less power than an ordinary flashlight. These are a few of SONAC's advantages.




Send for this complete descriptive booklet. There's no cost or obligation.

PATENTS PENDING

DELAVAN
Manufacturing Company
WEST DES MOINES • IOWA

## This kind of outstanding performance can be yours . . .

• You, too, can have the benefit of *planned mechanized handling*. Confusion and re-handling are virtually eliminated, and in their place is created a smooth, continuous flow of product through processing, warehousing and shipping.

For up-to-the-minute materials handling, we believe you get the best there is when you buy equipment that is *Mathews Engineered—Mathews Planned—Mathews Built* for you.

| | |
|---|---|
| GENERAL OFFICES | MATHEWS CONVEYER COMPANY<br>Ellwood City, Pennsylvania |
| WESTERN DIVISION | MATHEWS CONVEYER COMPANY WEST COAST<br>San Carlos, California |
| CANADIAN DIVISION | MATHEWS CONVEYER COMPANY, LTD.<br>Port Hope, Ontario, Canada |

*Over Fifty Years of Leadership in Mechanized Handling*

MATHEWS

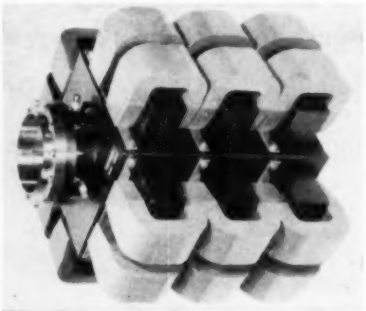

paid, the information on the card, now stored in the reader, is released to an automatic warehouse. There, a system of slanting shelves, each with an escapement mechanism at its exit end, releases the purchased items and deposits them on a moving belt leading to a collection point. Total time for dispensing as many as 100 different items from stock is about 15 seconds.

Advantages claimed for the system include: Reduction of sales floor space by approximately 50 per cent, faster and more accurate cash handling, and automatic warning of low stock conditions. Sales motivation by seeing and handling, and impulse buying opportunities, are retained with the automatic system.

## Bendix To Distribute Ferranti Numerical Controls

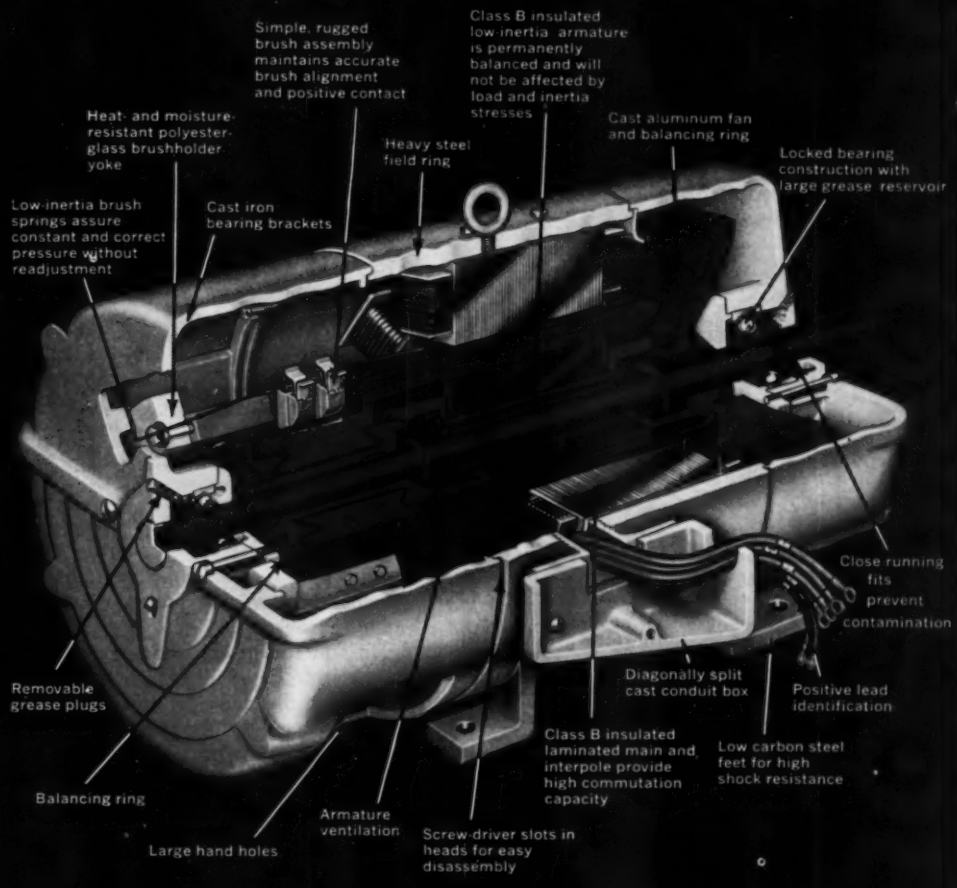
APPOINTMENT of Bendix Aviation Corp. as sole U. S. distributor and service representative for machine tool numerical control systems manufactured by Ferranti Ltd. has been announced by **G. S. Knopf**, manager of the Bendix Industrial Controls Section.

The Ferranti line includes a punched tape positioning system, a magnetic tape contouring system, and a co-ordinate inspection machine. In each system, accuracy and repeatability of machine movements are obtained through use of optical gratings attached to the moving machine elements. Fringe patterns



USEFUL in vacuum tube and semiconductor processing fields, a vacuum pump developed by Ultek Corp. has no moving parts. In operation, a cold-cathode discharge in a magnetic field removes gas molecules and atoms from circulation by the formation of chemically stable compounds and by ion burial. Device can also be used as a gage since current is drawn in linear relationship to pressure.

## Here's the latest in D-C motor design:


Simple, rugged brush assembly maintains accurate brush alignment and positive contact
Class B insulated low-inertia armature is permanently balanced and will not be affected by load and inertia stresses
Heat- and moisture-resistant polyester-glass brushholder yoke
Heavy steel field ring
Cast aluminum fan and balancing ring
Locked bearing construction with large grease reservoir
Low-inertia brush springs assure constant and correct pressure without readjustment
Cast iron bearing brackets
Close-running fits prevent contamination
Removable grease plugs
Diagonally split cast conduit box
Positive lead identification
Class B insulated laminated main and interpole provide high commutation capacity
Low carbon steel feet for high shock resistance
Balancing ring
Armature ventilation
Large hand holes
Screw-driver slots in heads for easy disassembly

### ...and some easy-to-add field modifications

A-c tachometer for speed indication

A-c motor-driven blower with permanent dry-type filter for easy mounting on bearing bracket

Magnetic disc-type brake with d-c series or shunt, or a-c coils

Helical single, double, and triple reduction gear units for all ratios

# New Louis Allis FLEXITORQ® D-C MOTORS

### ...offer you vastly improved commutation–low brush wear–400% short-time overload capacity–and unmatched flexibility!

Bear this in mind: The Flexitorq is *not* just another *rerated* d-c motor. It's *all new*—and it's been designed to give you more for your power dollar — in superior performance, matchless field flexibility, and unrivalled economy of operation and upkeep.

Advanced armature design and brush construction offers improved commutation, faster response, and lower brush wear. Class B insulation system provides exceptional thermal endurance... is rated for 60°C rise for continuous duty... and creates a barrier to moisture, acids, alkalis, and other contamination.

The net result to you is reliable, trouble-free power for constant and adjustable speed drives. For example, Flexitorq gives you 400% faster acceleration, plus much better deceleration, reversing, and speed changing. You can safely impose 400% intermittent and 15% continuous overloads — and the high-torque design is a welcome plus when you need extra power for hard-to-start machines.

The new Louis Allis Flexitorq is lighter and more compact than previous d-c motors... lets you squeeze more power into less space... yet is actually *easier* to service! Brushes and entire brush-holder assemblies can be quickly inspected and removed without major disassembly. And since brush springs remain conveniently attached to the brush holders, brush changing is a simple affair.

Flexitorq d-c motors are available in sizes from 1 to 400 hp — in various enclosures. See your nearby Louis Allis District Office for information and application help. Or write for Bulletins 3150 and 3200 to The Louis Allis Co., 463 E. Stewart St., Milwaukee 1, Wis.

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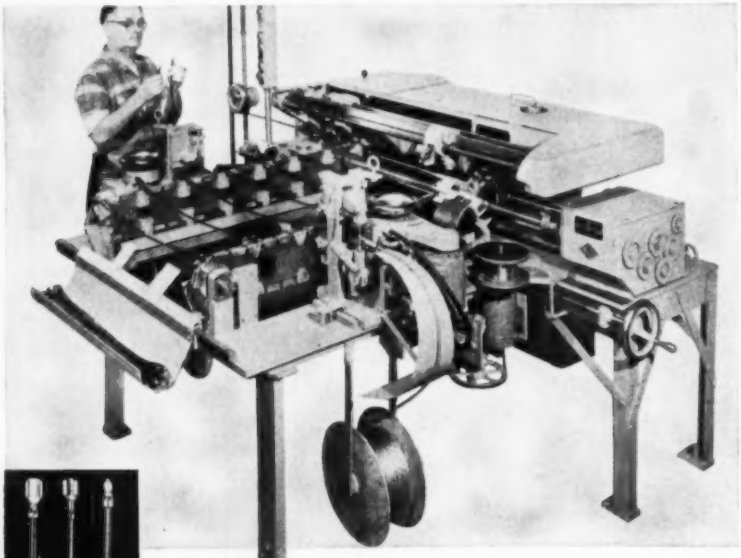
**LOUIS ALLIS**

DC-217

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

# Produce 4,000 finished wire leads per hour...with terminals at both ends!



## NEW ARTOS CS-9-AT AUTOMATIC MACHINE

1. measures any type of wire.
2. cuts off wire to length.
3. strips one or both ends.
4. attaches terminals at both ends.
5. provides stations for other work.

**NOW YOU CAN** produce up to 4,000 finished wire leads per hour—*with terminals attached at both ends*—when you install this new high-speed machine.

The ARTOS CS-9-AT handles almost any type of wire automatically. Taking wire from the reel, it measures, cuts to length, strips insulation, attaches terminals and provides uniform collection of the finished leads. Most types of terminals in prefabricated strip form can be used.

Also, the machine is furnished with a multi-station conveyor that permits several stations to be used for secondary operations such as inspection, twisting, welding, etc.

Get the complete story on the new ARTOS CS-9-AT—ask for engineering advice on your special problems.

**ARTOS CS-9-AT CAPACITY**

**Wire Sizes:** 20-gauge to 4-gauge.
**Cutting Lengths:** 6" min. to 90" max.
**Stripping Lengths:** ¼" to 1½".
**Output:** 6"-45" lengths—4,000 per hr.
45"-90" lengths—2,000 per hr.

***Write for Free Bulletins***

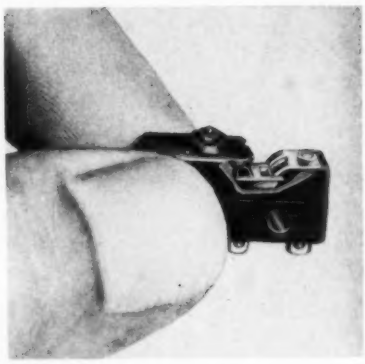
Bulletin 358 describes CS-9-AT machine. Also ask about other Artos machines to handle wire from 30 to 000 gauge; cut lengths from 2 in. to 45 ft.; strip insulation from ⅜ in. to 10½ in.

AGENTS THROUGHOUT THE WORLD

*World Leaders in Automatic Machines for Finishing Wire Leads*

**ARTOS ENGINEERING CO.**

**2785 South 28th Street • Milwaukee 46, Wisconsin**

SUBMINIATURE snap-action switch announced by Micro Switch Div., Minneapolis-Honeywell Regulator Co., employs gold contacts for sustained low contact resistance and reliable operation. Unit is designed for low-energy switching applications in millivolt and milliampere ranges.

set up by the gratings activate photocells that provide accurate position feedback signals.

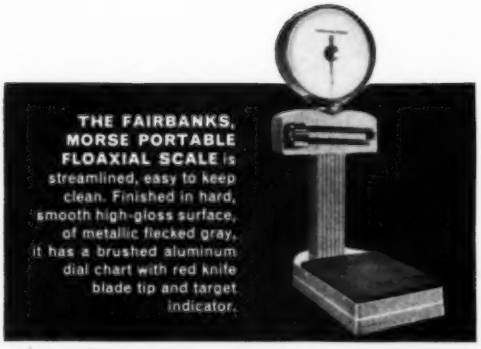
In announcing the business agreement with the British firm, Knopf said that the addition of the Ferranti systems to the present line of Bendix numerical controls for machine tools will make available to U. S. industry one source for numerical control engineering and equipment requirements. He added that Bendix will continue research and development of new numerical control systems to provide the best possible systems for industry.

### Mass Flowmeter Measures Ethylene Flow Directly

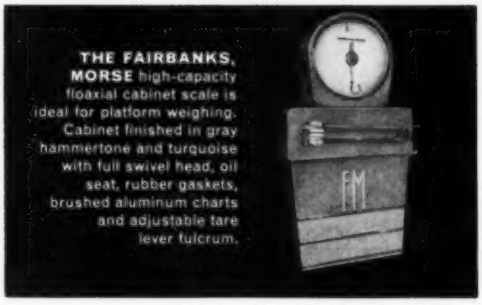
SOLUTION to difficulties long associated with accurate flow measurement of ethylene gas has been proved in field tests by General Electric Co. Using the company's recently-introduced industrial mass flowmeter, it is now possible to measure ethylene flow directly in pounds with an accuracy of 1 per cent.

With conventional orifice meters, data must be mathematically corrected to compensate for ethylene's noncompliance with physical laws of gas behavior. Time-consuming calculations to derive orifice coefficients and to correct and integrate chart records—all possible sources of human error—are eliminated with the new instrument. Since the flowmeter continuously registers total ethylene flow, it is

# add the weight of 130 years experience for quality you can count on



**THE FAIRBANKS, MORSE PORTABLE FLOAXIAL SCALE** is streamlined, easy to keep clean. Finished in hard, smooth high-gloss surface, of metallic flecked gray, it has a brushed aluminum dial chart with red knife blade tip and target indicator.




**THE FAIRBANKS, MORSE** high-capacity floaxial cabinet scale is ideal for platform weighing. Cabinet finished in gray hammertone and turquoise with full swivel head, oil seat, rubber gaskets, brushed aluminum charts and adjustable tare lever fulcrum.

**BY ANY SCALE OF VALUES** it's accuracy and adaptability to your own needs that counts when you're selecting weighing apparatus. Fairbanks, Morse is the one company uniquely equipped to meet your requirements. For since 1830 we have been designing dependable equipment for industry, until today F-M is the world's largest manufacturer of scales and automated weighing systems.

Today we proudly present a wider line, ranging from baby scales to electronic weighers that will accommodate entire trains! There are models for countless industrial applications . . . including **yours!**

Yet diverse and intricate as these applications may be, every F-M scale, every weighing accessory incorporates the built-in trademarks of F-M engineering skill and integrity . . . **utmost accuracy, ruggedness, long life . . . plus ease of service and simplified maintenance.**

Whether your weighing needs are mechanical or electronic . . . for Floaxial Printomatic weighers—or simply a health scale for your First Aid Department, you can look to Fairbanks, Morse for the right answer. Remember, the oldest, most experienced company is in business to find the **newest** ways to serve you!

# Fairbanks, Morse

**Scale Division · Fair Lawn, New Jersey**

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**



*Circle 670 on Page 19*

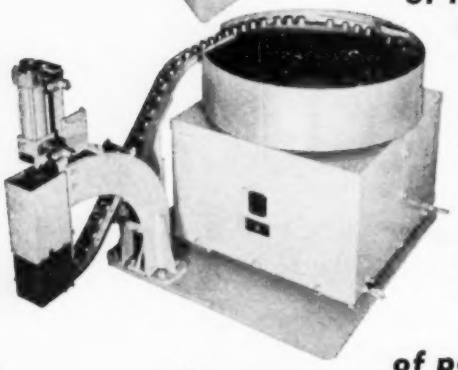
# THE CARE AND FEEDING

*of parts discharged at high or low heights*

**DPS ELEVATING FEEDERS** elevate, orient and feed parts of almost any size, shape and material to other machinery for processing and assembly. High capacity storage bins are designed to assure a steady flow of parts to elevating mechanism regardless of load level.

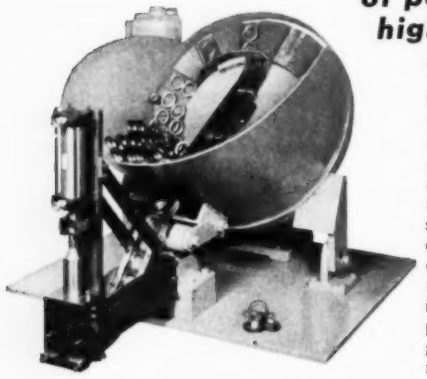
Orientation of parts is accomplished at discharge point of elevator — simplifying external track construction. Feeder can be arranged for right- or left-hand discharge. Return chutes are cushioned.

*New Bulletin 2812* has full data on DPS elevating feeders. Write for your copy today.



*of fragile or finished parts*

**DPS VIBRATORY FEEDERS** are bowl type units that gently handle parts too light or fragile to be handled in rotary type feeders. Through a simple electromagnetic drive, a vibrating action is transmitted to the bowl causing the parts to move up a circular, inclined track. The oriented parts then enter feed tube or discharge track to machining or assembly areas.



*of parts for high-production assembly*

**DPS ROTARY FEEDERS** employ radially slotted or grooved rotating collector rings. Efficient orienting and feeding of parts is achieved through proper design and engineering of baffle plate, selector guard, feed track, and escapement mechanism. Three different designs are available to meet holding, orienting and feeding requirements. Safety clutch prevents damage to motor or gears in the event of parts jamming.

**Detroit Power Screwdriver Company** offers industry's most complete line of selective feeders . . . ranging in holding area from 80 cu. in. to 20 cu. ft. For complete details, call your DPS representative or write direct. *Ask for free catalogs!* 15,335

**DETROIT POWER SCREWDRIVER COMPANY**
2811 W. Fort St. • Detroit 16, Michigan
*A Subsidiary of Link-Belt Company*


only necessary to subtract one reading from another to determine flow during any period of time.

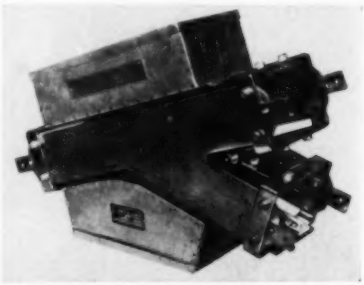
The mass flowmeter incorporates a gyro-integrated, angular-momentum system. Variations in pressure, temperature, and density of the measured substance have no effect on the accuracy of the device.

Totalized readings are indicated on a counter, and the flowmeter also has provision for connecting conventional electromechanical remote counters. Models will also be available that can transmit signals directly to chart recorders for continuous recording and control of mass rates of flow.

Present applications for the mass flowmeter include measurement of flow of natural gas, air, naphtha, jet fuel, freon, and liquid carbon dioxide.

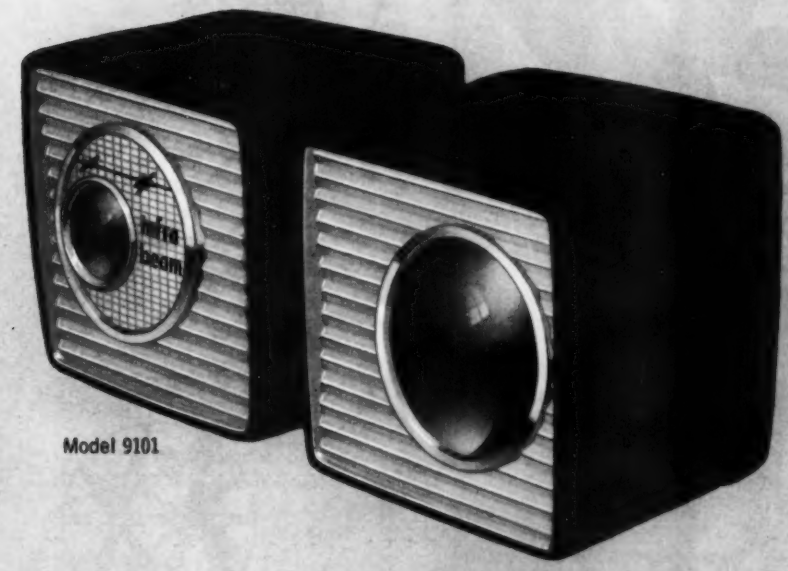
## SPOTLIGHTING PEOPLE

**H. E. Hanson** named vice president of Fairbanks, Morse & Co. and appointed general manager of the Beloit Division. . . . **William R. Hough** named vice president of research, development, and engineering for Reliance Electric and Engineering Co. . . . **Edward E. Kirkham** appointed chief engineer of the machinery engineering department at Pratt & Whitney Co. Inc. . . . **William Blandy** named manager of manufacturing for Hitemp Wires Inc. . . . **Gilbert E. Perkins** appointed production manager of American Emery Wheel Works. . . . **Glenn W. Bailey** appointed manager of manufacturing



MAGNETIC divider switch developed by Gemco Electric Co. changes the direction of flow of a train of metal cans fed by gravity. Designed for installation in cannery conveyor systems, the switch can be operated remotely from a control panel. No moving parts are required in the electromagnetic device.

# Announcing
# Infrabeam
## ...the revolutionary photoelectric control using modulated infrared radiation



Model 9101

**FOR THE FIRST TIME,** photoelectric control is *simple, reliable,* and *practical* over an extremely wide range of applications.

*Infrabeam* is a totally new type of photoelectric control . . . developed and tested over a period of more than a year, now ready to go to work in your plant or as part of equipment you manufacture. It offers a combination of simplicity, sensitiveness and reliability that has never before been achieved.

New infrared detectors, perfected for missile guidance, are in many ways superior to photocells that respond to visible or ultraviolet light. In Infrabeam, the Receiver contains a similar infrared detector which is screened against visible light by a simple optical filter. Further, the infrared beam from the Projector is "modulated" — brightening and dimming at a frequency of 400 cycles per second. The Receiver is electronically tuned to this frequency, so that the control will not respond unless it gets a signal from the associated Projector.

### WHAT THIS MEANS TO YOU...

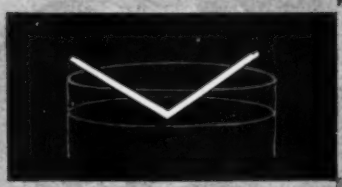
Compared with standard "general purpose" photoelectric controls, Infrabeam provides far greater sensitiveness in countless applications at close or moderate range. At extreme range — as much as 1000 feet — it offers superior reliability and freedom from interference. Because it operates equally well by reflecting the infrared beam from a detected object and into the Receiver, it is the *only* photoelectric control able to reach into "blind" areas with perfect freedom of installation.

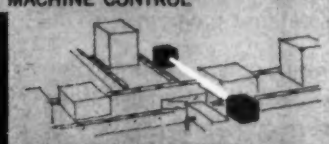
Projector and Receiver are attractively housed in anodized cast aluminum. The quick-detach hinge allows easy separation for use as opposed units, or accurate angling for use in reflection. Physical mounting and electrical connections are simplicity itself, and permit quick replacement of either unit without disturbing permanent wiring.

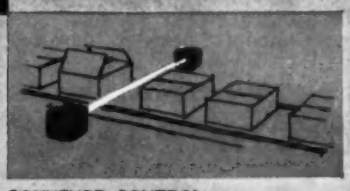
Find out how simple and practical photoelectric control can be for *you.* WRITE TODAY FOR COMPLETE DETAILS AND SPECIFICATIONS.

LONG-RANGE DETECTION

MACHINE CONTROL


LIQUID LEVEL CONTROL


INSPECTION OR SORTING


CONVEYOR CONTROL

ELECTRONICS DIVISION

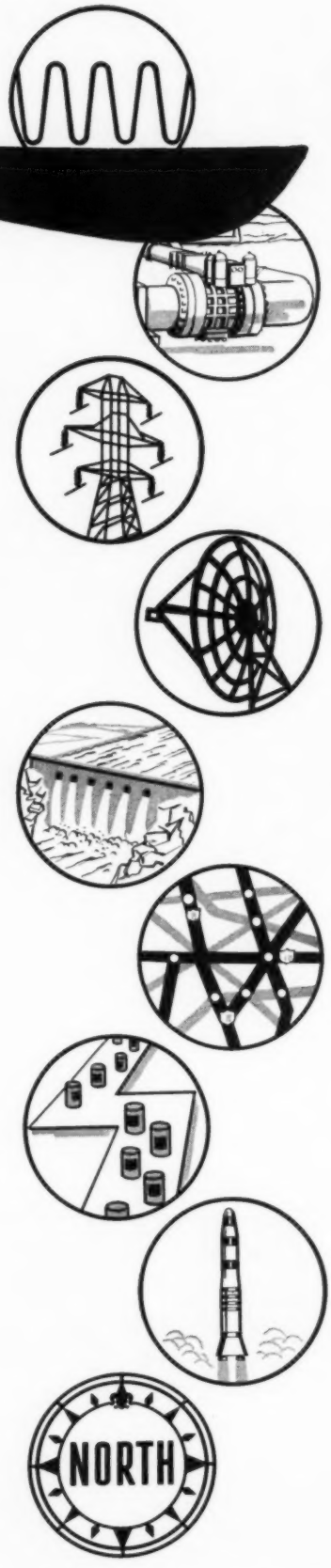
**CRAMER CONTROLS**

CORPORATION

CENTERBROOK, CONNECTICUT

Circle 672 on Page 19

# our business is communications and control systems...



For over 75 years North Electric has been designing, engineering and manufacturing "systems" designed on the dual functions of communications and control.

Today, North Systems speed man's thoughts and words over vast distances, between continents and over oceans in seconds.

Today, North Systems control the flow of light, heat, power and water for homes and industry, petroleum products for the wheels of America and chemicals for industry.

Today, North Systems are at work on land, sea and in the air as integral cogs in our vast transportation network.

Today, North Systems make possible high speed data processing complexes functioning through highly efficient switching centrals.

Today, North Systems automate production tools and production lines, handle packaging and pricing chores, perform scientific testing, measuring, weighing and analysis, and hosts of similar functions.

Today, North Systems help BMEWS guard our frontiers, add to our missile capability in projects THOR and JUPITER and help keep our nation safe and strong in many other defense programs.

At North Electric, the engineering team represents a cadre of professional competence with the solid background that comes from long experience in the application of system concepts.

To learn what North can do for you, systemwise, today and tomorrow, write for your copy of "North System Concepts" booklet—now.

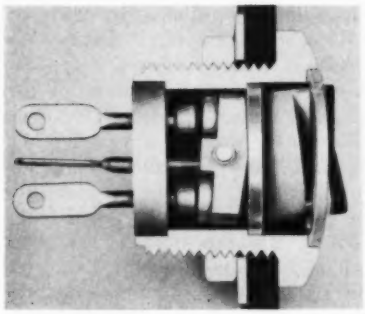
*ELECTRONETICS DIVISION*

***NORTH ELECTRIC COMPANY***

*626 S. Market St.* *Galion, Ohio*



Circle 673 on Page 19



MINIATURE electrical switch developed by Space Components Inc. is suitable for operation in severe environments including shock, vibration, and temperatures to 900 F. Sealed construction permits operation under water and in high pressures. A permanent magnet provides force to actuate the switch. When properly positioned, the magnet attracts an armature in a sealed chamber, causing switching to occur.

administration, and **Paul G. Richards** named manager of manufacturing facilities at International Telephone and Telegraph Corp. . . . **Edward W. Ruhe** promoted to the newly-created position of chief engineer of the engineering and maintenance department, Metals Div. plant, Olin Mathieson Chemical Corp. . . . **Harold M. Schudt** named director of manufacturing for Allis-Chalmers International and will direct manufacturing activities for foreign plants in England, Mexico, Italy, and Australia. . . . **Leith Johnston** appointed director of a newly-created industrial systems development department of Automatic Electric Laboratories, subsidiary of General Telephone & Electronics. . . . **Albert P. Tis** named operations manager of the Ketay Dept., Norden Div., United Aircraft Corp. . . . **Louis G. Good** appointed vice president in charge of operations for Panellit Service Corp., subsidiary of Information Systems Inc. . . . **Donald Hunter** named semiconductor production superintendent for the CBS Electronics Div., Columbia Broadcasting System Inc. . . . **Robert O. Bullard** elected vice president and general manager of the Electronics and Instrumentation Div., Baldwin-Lima-Hamilton Corp. . . . **Martin J. Crean** appointed director of data processing for Sperry Gyroscope Co. . . . **Roy N. Sundstrom** named senior project engineer for the Electrical Products Div., Corning Glass Works. . . . **William Flanagan**

■ This new double tool plate indexing machine chassis represents a fresh approach to automatic assembly and processing. Tooling is center mounted on the lower tool plate . . . actuation is provided by the upper tool plate. A cam shaft extension is also available for supplementary tool actuation.

The new design represents an important advance in the SWANSON INTEGRATED CONCEPT that incorporates all necessary facilities for *work transfer, tool mounting* and *tool actuation* in a standard chassis that is built to give you . . .

***better automatic machines for less cost in less time***

***Write for Details . . . without obligation***

**SWANSON-ERIE CORPORATION**

SEC

802 EAST 8th STREET
ERIE, PENNSYLVANIA

***Designers and Builders of Automatic Assembly and Processing Machines.***




Circle 674 on Page 19

# Another H&S Speed Reducer

## *on a tough job...*

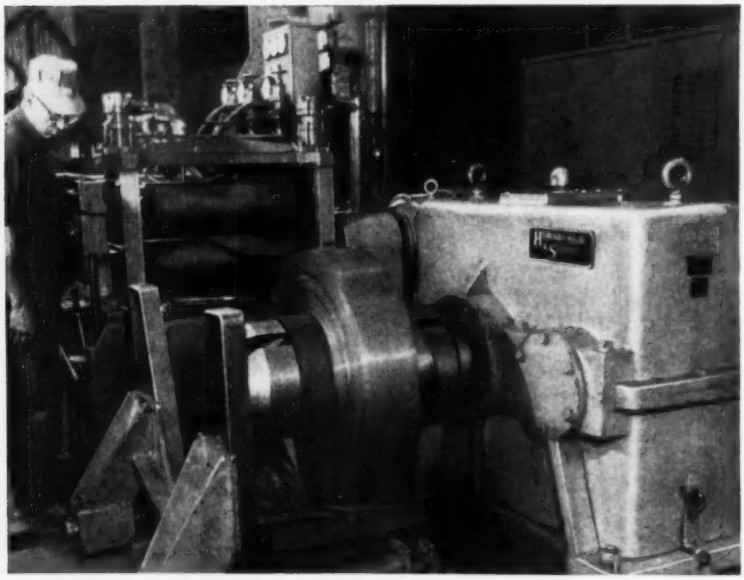
Built rugged for a critical rewind operation, this heavy overhung-load type H & S Herringbone Speed Reducer delivers day-in-day-out service under exacting load conditions.

This standard unit was selected for use on a Bliss precision rewind coiling machine—where strip steel must undergo tension controlled recoiling for subsequent annealing treatment.

Notice the sturdy shaft, with heavy-duty bearings designed to take this heavy overhung load. Observe the rugged housing, made to last.

This built-in toughness typifies H & S construction—on helical, herringbone, worm and combination units.

Send for detailed information on our facilities for producing a complete line of gears and speed reducers in a wide range of sizes and ratings.



Heavily loaded pay-off reel being driven by H & S Speed Reducer in plant of The Acme Steel Company, Chicago.

**The HORSBURGH & SCOTT CO.**

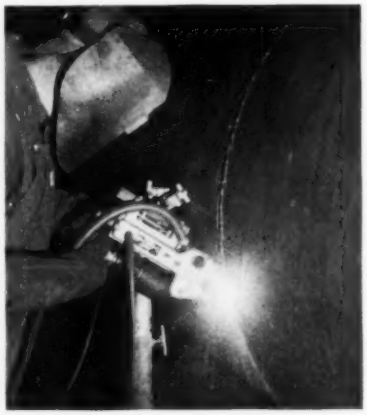
5112 Hamilton Avenue • Cleveland 14, Ohio

Specializing in fast production of quality Speed Reducers and Gearing to meet custom requirements.


appointed general manager of Pacific Automation Products Inc. . . . **Richard A. Green** elected vice president and general manager of the Pioneer Industrial Engineering Div., Pioneer Engineering & Mfg. Co. Inc. . . . **Chester C. Holloway** named president of Gilman Engineering and Mfg. Co., wholly owned subsidiary of Parker Pen Co. . . . **Raymond M. Cotter** appointed director of manufacturing for semiconductor operations, Lansdale Div., Philco Corp. . . . **P. R. Holmes** named assistant plant manager, and **W. J. Wiley** appointed manager of manufacturing for the Downey plant, Aerojet-General Corp.

## SPOTLIGHTING PLANTS

**Conveyor Systems Inc.** has acquired the Farquhar Div. of the Oliver Corp. The new acquisition will operate as a division of Conveyor Systems and will manufacture pre-engineered conveyors for commercial, industrial, and bulk handling fields. . . . **Amperex Electronic Corp.** has acquired a new 40,000 sq ft plant in

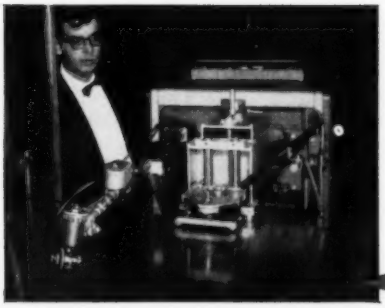


CIRCUMFERENTIAL seams for heat exchangers, columns, and pressure vessels are prepared for final external welding with this semiautomatic arrangement at Sistersville Tank Works Inc. In a first operation, mating steel plate sections are butted and tack welded on the outside. A permanent weld is then made on the inside by a submerged arc welding process. With the assembly rotating on powered rolls, an Arcair Co. gouging torch is then used to form a U-groove extending to the root of the interior weld. In operation of the torch, a consumable carbon graphite electrode melts the metal as a compressed air stream blows excess molten metal away. After the groove has been formed, the sections are welded on the outside to complete the assembly.

## Called for Sperry Ultrasonics

**At Chrysler Corporation, Sperry collaborated with methods researchers to develop an improved ultrasonic inspection system. The new system, named SIMAC (Sonic Inspection Measurement and Control), automatically tests sheet steel for internal flaws in excess of 400 feet a minute. Flaws are marked by dye and the faulty steel rejected before it reaches the stamping phase. The resultant quality control assures the most perfect product with the least waste of man hours and material.**

***Should your blueprint for quality require ultrasonics, X-ray or magnetic particle testing, call on Sperry. We are fully prepared to evaluate your quality control problem and help you choose the most efficient nondestructive test system.***



**Defective sheet steel is automatically sprayed with dye on the production line at Chrysler's Nine Mile Stamping Plant.**

**Sperry Products Company**

DIVISION OF HOWE SOUND COMPANY

1206 SHELTER ROCK ROAD, DANBURY, CONNECTICUT



*Circle 676 on Page 19*

# SELECTROL®
## Automatic Checkweigher

- WEIGHS
- CLASSIFIES
- SORTS

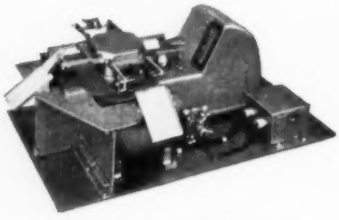
. . . with unvarying accuracy

This Selectrol precision checkweigher is capable of proving weight accuracies in the range of 1 part in 5,000 to 1 part in 20,000. Automatic transfer mechanism places commodity on the scale and removes it. Operating speeds up to 60 units per minute depending on capacity and accuracy required.

Selectrol employs a Shadograph, an extremely sensitive scale with a light-projection indication system that provides visual readings. Optional accessories include recording, counting, signaling and control devices.

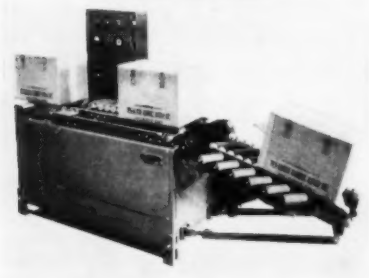
Selectrols are made by Exact Weight, a manufacturer of scales for 45 years and with experience in hundreds of checkweighing installations. Write for Bulletin 3347.

**MODEL 145 SELECTROL** has in-line "walking deck" type transfer mechanism.



**MODEL 144 SELECTROL** has rotary transfer mechanism. Automatic selection or rejection is provided immediately following the weigh station.

### New Case and Bag Checkweigher



Model 1250 Selectrol, for checking cases, cartons and bags from 20 lbs to 100 lbs., offers accuracy one-tenth-of-one per cent. Speeds up to 30 units per minute. Model shown has over and under weight rejection. Also supplied with underweight rejection only or without rejection mechanism. Optional equipment available for machine control, recording, counting and visible or audible signaling. Write for Form 3280.

**THE EXACT WEIGHT SCALE CO.**
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.

Exact Weight SCALES

*Sales and Service Coast to Coast*

Find us in your local 'Yellow Pages'

BETTER QUALITY CONTROL . . . BETTER COST CONTROL

CURRENT and voltage limit detectors developed by the Control Systems Div., Daystrom Inc., are suitable for continuous monitoring of low-level voltages from thermocouples, strain gage bridges, and other types of transducers. Voltage detectors operate an alarm when an input voltage exceeds a preset limit; current detectors respond to both high and low limits. Equipment shown includes a current detector (top) and a multi-input control unit (bottom).

Slatersville, R. I., to be used for the automated production of post alloy diffusion transistors and diodes. . . . **Remington Rand Div., Sperry Rand Corp.**, has entered into an agreement to purchase the Adding Machine and Cash Register Division assets of Clary Corp. The transaction, subject to approval by stockholders of both companies, will include all the physical assets of Clary's manufacturing plant in Searcy, Ark., and the Clary name will be retained on the line of adding machines and cash registers. . . . **Kellogg Switchboard and Supply Co.**, communications division of International Telephone and Telegraph Corp., will build a new 82,500 sq ft plant in Corinth, Miss., to house its telephone manufacturing operations. . . . **Bell & Howell Co.** and its California subsidiary, Consolidated Electrodynamics Corp., have combined their research activities into a single, expanded research division. The new division will be located at CEC's headquarters in Pasadena and will be responsible to Philip S. Fogg, president of CEC. . . . **Lerco Electronics Inc.** has acquired the assets of Automation Development Co. which produces logic systems for controlling stepper motors. . . . **Dracco Div., Fuller Co.**, has started construction of an 18,000 sq ft addition to its plant in Cleveland for the manufacture of dust collection and pneumatic conveying equipment. . . . **Systems Div., Beckman Instruments**

*For Literature on Hannifin Items, Circle 678→*
*For Literature on Fittings & Hose, Circle 679→*



*Circle 677 on Page 19*

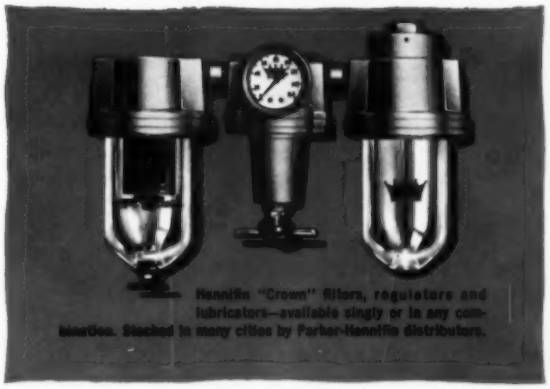
Hannifin air power cylinders, available in a full range of mounting styles, bore sizes from 1½" through 14", strokes to 20 feet. Cylinder bodies bored, then honed satin-smooth . . . for low friction, long packing life.

Hannifin's complete line of air control valves includes electric solenoid-, pressure-, cam-, hand-, and foot-actuated valves. Write for our catalog and "Valve Finder."

# PARKER-HANNIFIN
## puts air to work without costly leaks

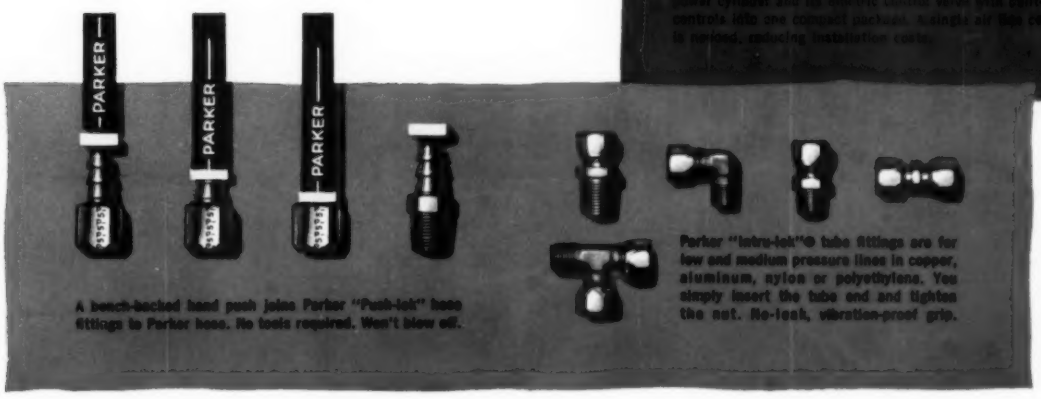
Now . . . complete pneumatic power systems, engineered for long leak-proof life, are available from your Parker-Hannifin man. Hannifin "Crown" units supply filtered, lubricated air at optimum pressure. Hannifin air valves shift quickly and seal bubble-tight. Hannifin air cylinders and air motors are low-friction, leak-proof. Parker "Push-lok" hose fittings and "Intru-lok" tube fittings provide quick, easy, leak-proof connections. The over-all result is more work from less air!

Our field engineering service helps you design your circuits and select the components. Many items are available locally, from Parker-Hannifin distributor stocks.



Hannifin "Crown" filters, regulators and lubricators—available singly or in any combination. Stocked in many cities by Parker-Hannifin distributors.

The Hannifin air motor combines a high-efficiency, leak-proof power cylinder and its electric control valve with built-in speed controls into one compact package. A single air line connection is needed, reducing installation costs.



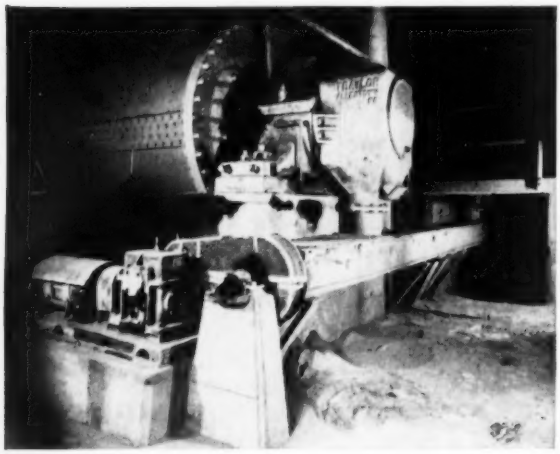

A bench-backed hand push joins Parker "Push-lok" hose fittings to Parker hose. No tools required. Won't blow off.

Parker "Intru-lok"® tube fittings are for low and medium pressure lines in copper, aluminum, nylon or polyethylene. You simply insert the tube end and tighten the nut. No-leak, vibration-proof grip.

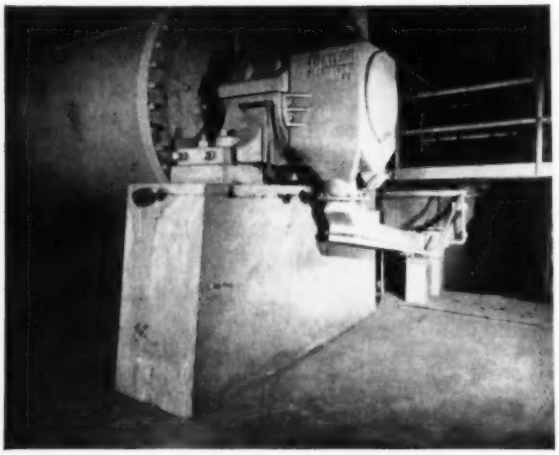
Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

HANNIFIN COMPANY
555 S. Wolf Road, Des Plaines, Illinois

## The Arithmetic of Materials Handling



**BEFORE:** **Dirt, noise and mechanical breakdown** were constant problems in this cement plant, where two mechanical conveyors were used to collect raw materials. A 5 h.p. motor driving auxiliary equipment wasted valuable space and power, required frequent maintenance. Spillage clean-up wasted costly man-hours.



**AFTER:** **Clean, simple, quiet.** Notice the difference two 8" F-H Airslide® fluidizing conveyors have made. No dangerous moving parts. Nothing to lubricate. Auxiliary equipment and foundations are gone. Power needs are now only 1/8 of previous needs. Fluidizing saves wear and maintenance.

# AIRSLIDE® Fluidizing Conveyor

## minimizes material loss . . . maintenance . . . moving parts

If you are now handling dry, pulverized materials, the F-H Airslide Fluidizing Conveyor can help you stop noise, and air-pollution, as well as speed flow and reduce maintenance cost.

### Simplicity Itself

F-H Airslide conveyors fluidize dry, pulverized materials with low pressure air.

These materials literally flow at high speed, down the inclined conveyor. Power requirements are small.

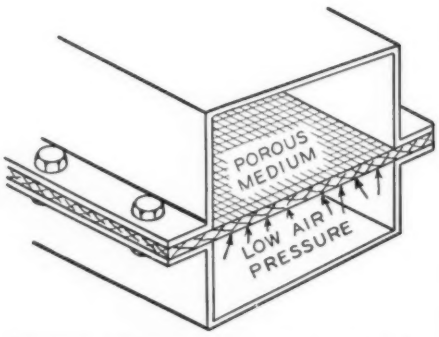
### Flexibility, Low Cost

For unlimited applications, Airslide conveyors take up little space, and can be used singly and in combination with other Fuller pneumatic conveying systems. The movement of fluidized material can be around corners, between floors, through walls—nearly any conveying distance.

### Better Housekeeping

Can Fuller conveying systems help eliminate your housekeeping problems—cut your maintenance and handling costs? Write today, outlining your problem in handling dry, finely-divided materials. Fuller will gladly make appropriate recommendations.

## "Pulverized Materials Flow Like Water!"




**FLUIDIZING PRINCIPLE:** Porous supporting medium divides conveyor section into two "compartments". Dry material flows down inclined conveyor, fluidized by low-pressure air entering beneath porous medium.

FULLER COMPANY GENERAL AMERICAN TRADE MARK

**Fuller**
. . . . pioneers in harnessing AIR

**FULLER COMPANY**
**162 Bridge St., Catasauqua, Pa.**
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

4483
FH 59



Circle 760 on Page 19

Inc., has formed a new Computer Applications Group to provide technical support in the integration of computing equipment and large-scale data processing system installations. . . . **Cutler-Hammer Inc.** is planning to construct a new plant in Belmont, Calif., to house the company's San Francisco manufacturing, sales office, and warehouse activities.

## MEETINGS & EVENTS

**June 5-10—**

**American Society of Mechanical Engineers.** Semiannual meeting and aviation conference will be held Statler-Hilton Hotel, Dallas. Details are available from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

**June 5-10—**

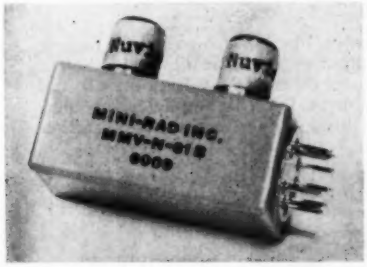
**Society of Automotive Engineers.** Summer meeting scheduled for Edgewater Beach Hotel, Chicago. For more information contact SAE headquarters, 485 Lexington Ave., New York 17, N. Y.

**June 6-8—**

**Material Handling Institute.** New England show to be held Commonwealth Armory, Boston. Educational meetings will be sponsored by the American Material Handling Society. More information is available from W. L. Redding, Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

**June 8-11—**

**National Society of Professional Engineers.** Annual meeting will be




PLUG-IN multivibrators employing nuvistors (rugged vacuum tubes developed by Radio Corp. of America) are available from Mini-Rad Inc. Monostable, astable, and bistable multivibrator models, as well as Schmitt trigger units, are produced. Devices are applicable for pulse and gate generation, delay, counting, and amplitude comparison applications.

*Heat liquids*
*. . . . . at the turn of a dial*

**CHROMALOX**
**ELECTRIC HEAT**

***Fast, uniform, economical, safe***

**Just drill and install threaded pipe coupling in tank, then screw in the Chromalox Immersion Heater. Built-in thermostat automatically maintains uniform temperature of water, oils, paraffin, wax, various solutions. Several styles available, for different applications. Elements sheathed in copper or steel. Standard ratings from 50° to 550°F., ¾ to 10KW, 120 or 240 volts. Inside-tank extensions from 6¼" to 48". Available with explosion-resistant and moisture-resistant terminal box. Prices start under $20.**

**For more details, call your Chromalox Sales-Engineering Representative, or write us for Bulletin PD105, which contains specifications and prices.**

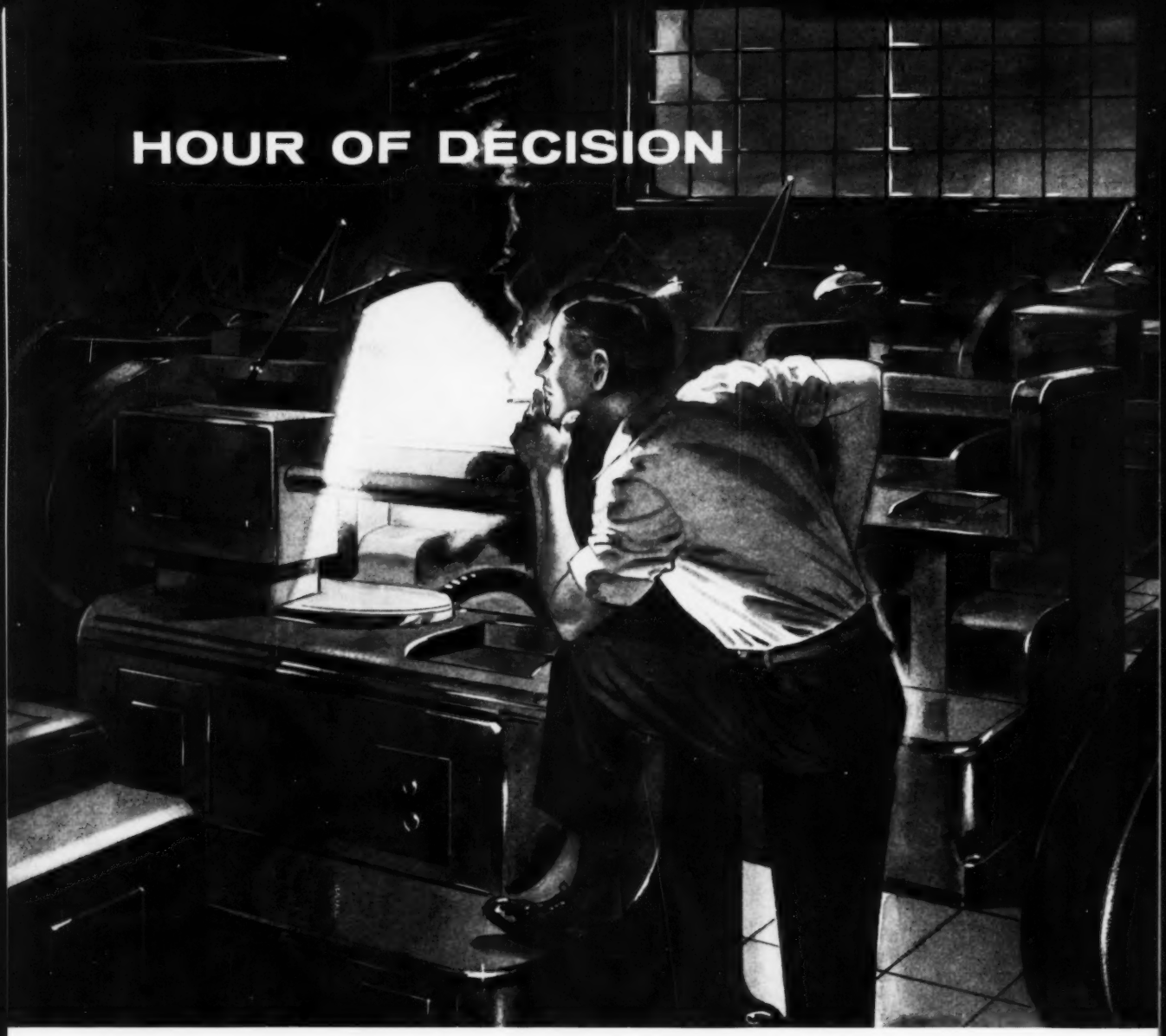
**Call Your Chromalox Man for Heating Answers**

ALBANY, N.Y. Hobart 3-0626
ATLANTA, GA. Trinity 5-7244
BALA-CYNWYD, PA. Mohawk 4-6113 Greenwood 3-4477
BALTIMORE, MD. Hopkins 7-3280
BLOOMFIELD, N.J. Edison 8-6900 New York, Worth 4-2990
BOSTON, MASS. Liberty 2-1941
BUFFALO, N.Y. Summer 4000
CHARLOTTE, N.C. Edison 6-4244 Franklin 5-1044
CHATTANOOGA, TENN. Amherst 5-3882
CHICAGO, ILL. Harrison 7-5864
CINCINNATI, OHIO Trinity 1-0605
CLEARWATER, FLA. Phone 3-7706
CLEVELAND, OHIO Prospect 1-7112
COLUMBUS, OHIO Amherst 7-8260
DALLAS, TEX. Riverside 8-9824
DAVENPORT, IOWA Phone 6-5233
DENVER, COLO. Glendale 5-3651 Genesee 3-0821
DES MOINES, IOWA Cherry 3-1203
DETROIT, MICH. (See Southfield, Mich.)
HOUSTON, TEX. Capitol 5-0256
INDIANAPOLIS, IND. Melrose 5-5313
KANSAS CITY, MO. Victor 2-3306
LOS ANGELES, CAL. Richmond 7-5191
MIDDLETOWN, CONN. Diamond 6-9606
MILWAUKEE, WIS. Broadway 1-3021
MINNEAPOLIS, MINN. Federal 8-4631
NASHVILLE, TENN. Cypress 2-7916
NEW YORK CITY, N.Y. (See Bloomfield, N.J.)
OMAHA, NEB. Atlantic 7020
PHILADELPHIA, PA. (See Bala-Cynwyd, Pa.)
PITTSBURGH, PA. Emerson 1-2900
PORTLAND, ORE. Capitol 3-4197
RICHMOND, VA. Atlantic 8-8758
ROCHESTER, N.Y. Hamilton 6-3070
ST. LOUIS, MO. Chestnut 1-2433
SAN FRANCISCO, CALIF. Underhill 1-3527
SEATTLE, WASH. Main 4-1797
SOUTHFIELD, MICH. Kenwood 8-2100 Elgin 7-0677
SYRACUSE, N.Y. Granite 4-3933
WICHITA, KAN. Amherst 7-5647




Circle 680 on Page 19

# HOUR OF DECISION



**IS THIS YOU?** How many times, after the call bell stops clanging, the customers stop phoning, and people stop asking questions, do you walk into the quiet shop to face up to the really vital decisions?

"How can we compensate for the rising costs of materials, overhead, payroll, maintenance?" "How can we keep producing the exacting tolerances, finishes, and quality our markets are demanding?" "How can we improve our production efficiency so that our narrow profit margin will not disappear altogether?" "How can we meet and beat the increasing world-wide competition in our field?"

One proved answer to these questions is the logical replacement of obsolete, inefficient machines. THE MACHINE TOOL EXPOSITION — 1960 will back up this fact with 11 acres of the latest developments in machine tools. Can you afford to miss seeing new, faster machine tools that will produce more efficiently . . . new, better methods that will cut satisfying chunks out of metalworking costs . . . new, ingenious ideas that will help you produce more quality for less cost?

Tool-up for the Sixties. Plan *now* to attend the largest, single-industry exposition ever held in the United States. Have your key personnel on hand, too. It's a once in five years chance to examine the latest technological advancements in automation through numerical controls and see why Modern Machine Tools = Production Efficiency!

Also see the PRODUCTION ENGINEERING SHOW on the Navy Pier. One registration covers both.

FORMULA FOR TOMORROW

MODERN MACHINE TOOLS MMT=PE PRODUCTION EFFICIENCY

International Amphitheatre
Chicago, Illinois
Sept. 6-16

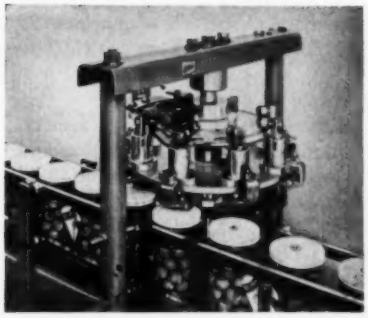
# THE MACHINE TOOL EXPOSITION — 1960

For information write to

NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

2139 Wisconsin Avenue, N.W. • Washington, D. C.

Circle 681 on Page 19



MULTISTAMP, rotary container marker developed by Adolph Gottscho Inc. is suitable for high-speed price marking of cans, jars, and bottles. Self-powered unit can be placed at any point in a conveyor line and is said to handle containers traveling at rates up to 1000 per minute. Surfaces that are recessed as much as $^{5}/_{8}$ inch can be stamped with the unit's rubber type.

held Statler Hotel, Boston. More information is available from NSPE headquarters, 2029 K St. N.W., Washington 6, D. C.

**June 13-15—**

**American Association of Cost Engineers.** Annual meeting planned at Rice Hotel, Houston, Tex. For further information contact E. D. Shanken, AACE, Durham, N. H.

**June 13-15—**

**Metal Powder Industries Federation.** International Powder Metallurgy Conference to be held Biltmore Hotel, New York. Additional information is available from MPIF headquarters, 60 E. 42nd St., New York 17, N. Y.

**June 13-15—**

**American Society of Heating, Refrigerating and Air Conditioning Engineers.** Annual meeting scheduled for Vancouver Hotel, Vancouver, B. C. Information can be obtained from society headquarters, 234 Fifth Ave., New York 1, N. Y.

**June 19-24—**

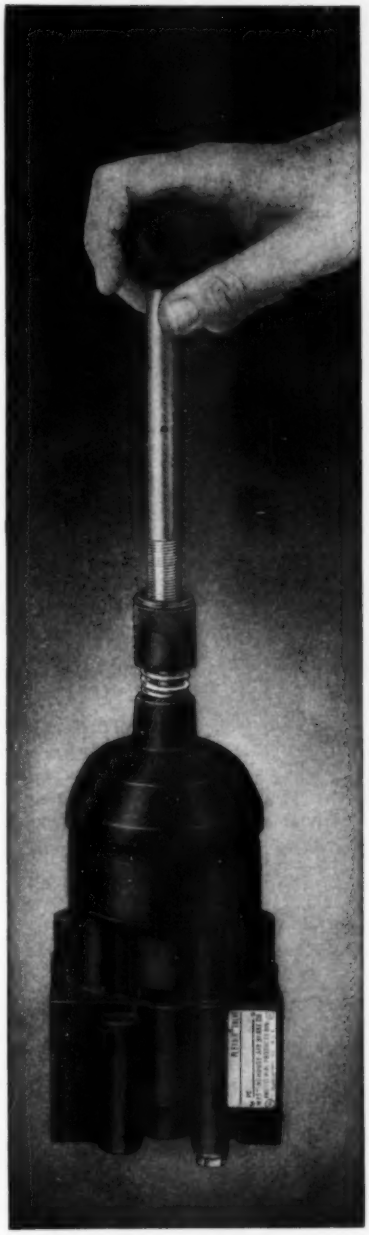
**American Institute of Electrical Engineers.** Summer general meeting to be held Chalfonte-Haddon Hall, Atlantic City, N. J. Details available from AIEE headquarters, 33 W. 39th St., New York 18, N. Y.

**June 20-22—**

**American Society of Mechanical Engineers.** Applied Mechanics Conference to be held at Pennsylvania State University, University Park,


# Another New Westinghouse AIR CIRCUITRY Component

(One of 30)



## The lightweight FLEXAIR® Valve

Provides effortless control. Position of the handle controls air pressure. Pressure is graduated between zero and maximum and automatically maintained. A light touch of the handle controls one, two or three outlets, separately or simultaneously.

The FLEXAIR Valve is only one of a growing list of interesting new AIR CIRCUITRY Components. Westinghouse AIR CIRCUITRY eliminates operator fatigue and errors in manual or semi-automatic operations and serves in completely automatic installations.

**AIR CIRCUITRY... FOR TROUBLE-FREE AUTOMATION**

Air Circuitry is the application of pneumatic control systems to your industrial production operations.

Air circuits are safe, economical and precise and are used to solve the most rigorous and complex control problems in industry.

Our engineers, backed by 90 years of experience, can help you boost production and cut costs in your plant.

**AIR CIRCUITRY means trouble-free automation**

**For more information, ask for Catalog A4-72.63.**

*See the Yellow Pages under Cylinders for the Name of Your Local Distributor, or refer to Sweet's Catalog, Product Design File.*

**WESTINGHOUSE AIR BRAKE COMPANY**

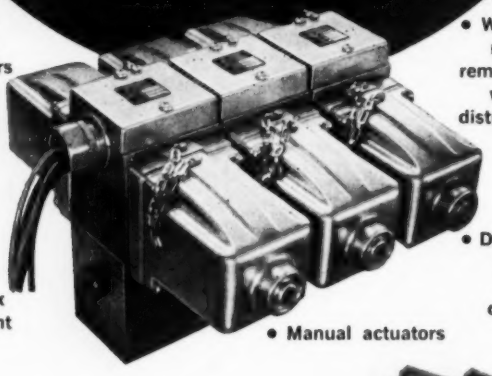
INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

# *NEW!

## BECKETT HI-CYCLIC

### 3/8" DIRECT ACTING SOLENOID VALVE FOR MANIFOLD MOUNTING

- Compact—mounts on 2⅝" centers—up to 5 units on a manifold.
- When multiple mounted can remove an inner valve without disturbing wiring of other valves.
- Built-in electrical junction box—vapor-tight seal.
- Direct solenoid operated—industrial, constant duty type.
- Manual actuators



TYPE:

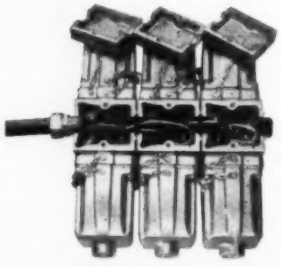
3/8" capacity double or single solenoid, spring return — fast reaction for accurate control.

2, 3, or 4 way, 2 or 3 position.

7 spool types available to meet all requirements.

Furnished with standard equipment or to JIC standards.

MEDIA:
Air, vacuum and all conventional hydraulic fluids.



- With junction box covers off, valve design provides wide open conduit for easy installation of wiring. All wiring readily accessible.
- Solenoid and junction box covers chained to valve body.

NFPA NATIONAL FLUID POWER ASSOCIATION MEMBER

WRITE TODAY FOR DETAILED INFORMATION

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**BECKETT-HARCUM CO.**

**983** W. LOCUST STREET, WILMINGTON, OHIO


Pa. Additional information is available from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

**June 20-24—**

**Cleveland Engineering Society.** National Invention's Exhibition and Creativity Conference to be held Cleveland Engineering and Scientific Center. Details are available from CES, 3100 Chester Ave., Cleveland 14, Ohio.

**June 22-24—**

**National Machine Accountants Association.** National conference and business show will be held Mark Hopkins Hotel, Fairmont Hotel, and California Masonic Memorial Temple, San Francisco. For further information write NMAA, P. O. Box 3617, Rincon Annex, San Francisco 19, Calif.

**June 26-July 1—**

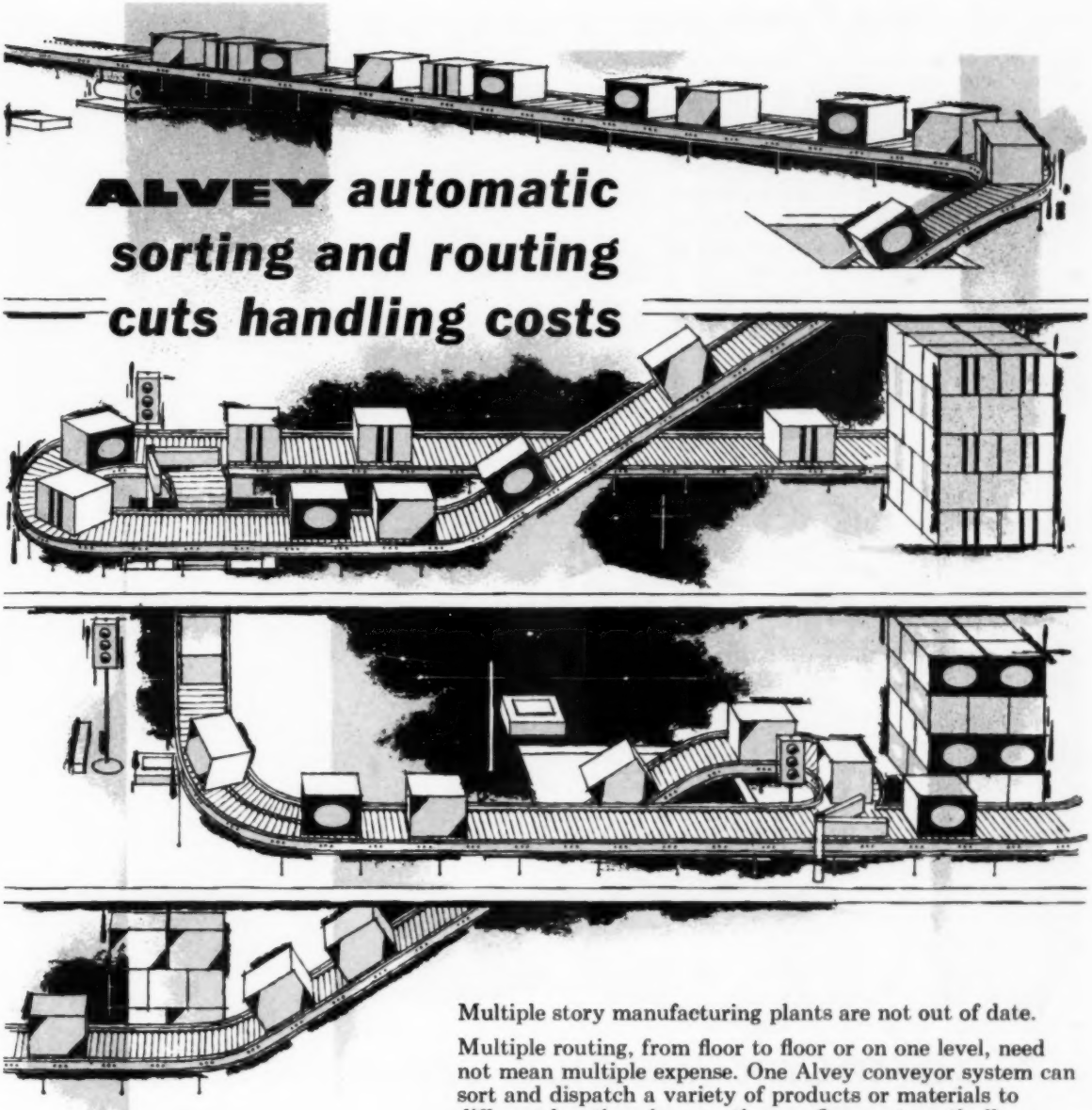
**American Society for Testing Materials.** Annual meeting and exhibit scheduled for Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. More information is available from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa.

**July 2-6—**

**National Tool & Die Manufacturers Association.** Summer meeting planned for Banff Springs Hotel, Banff, Alberta. For details contact association headquarters, 907 Public Square Bldg., Cleveland 13, Ohio.

AUTOMATION

*"You the one wanted to see the chart for No. 7 recorder?"*



# ALVEY automatic sorting and routing cuts handling costs

Multiple story manufacturing plants are not out of date.

Multiple routing, from floor to floor or on one level, need not mean multiple expense. One Alvey conveyor system can sort and dispatch a variety of products or materials to different locations in a continuous flow, automatically . . . untouched by human hands! Scanning devices can "read" your packages and dispatch them to the right destination.

Whether you need a completely-integrated conveyor system, or individual package handling units, put Alvey's experienced, creative conveyor engineering to work for you.

If you're planning to build, modernize—or if you're simply open to new ideas—call in Alvey. No obligation for consultation. **Alvey Conveyor Manufacturing Co., 9251 Olive Street Road, St. Louis 32, Mo.**

*Alvey . . . serving these famous names and many more*

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| A. E. Staley Mfg. Co. | Goodrich-Gulf Chemicals |
| Armour & Co. | Hiram Walker |
| Royal McBee Corp. | A.C.F.Wrigley |
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**ALVEY** *moves more for modern industry*

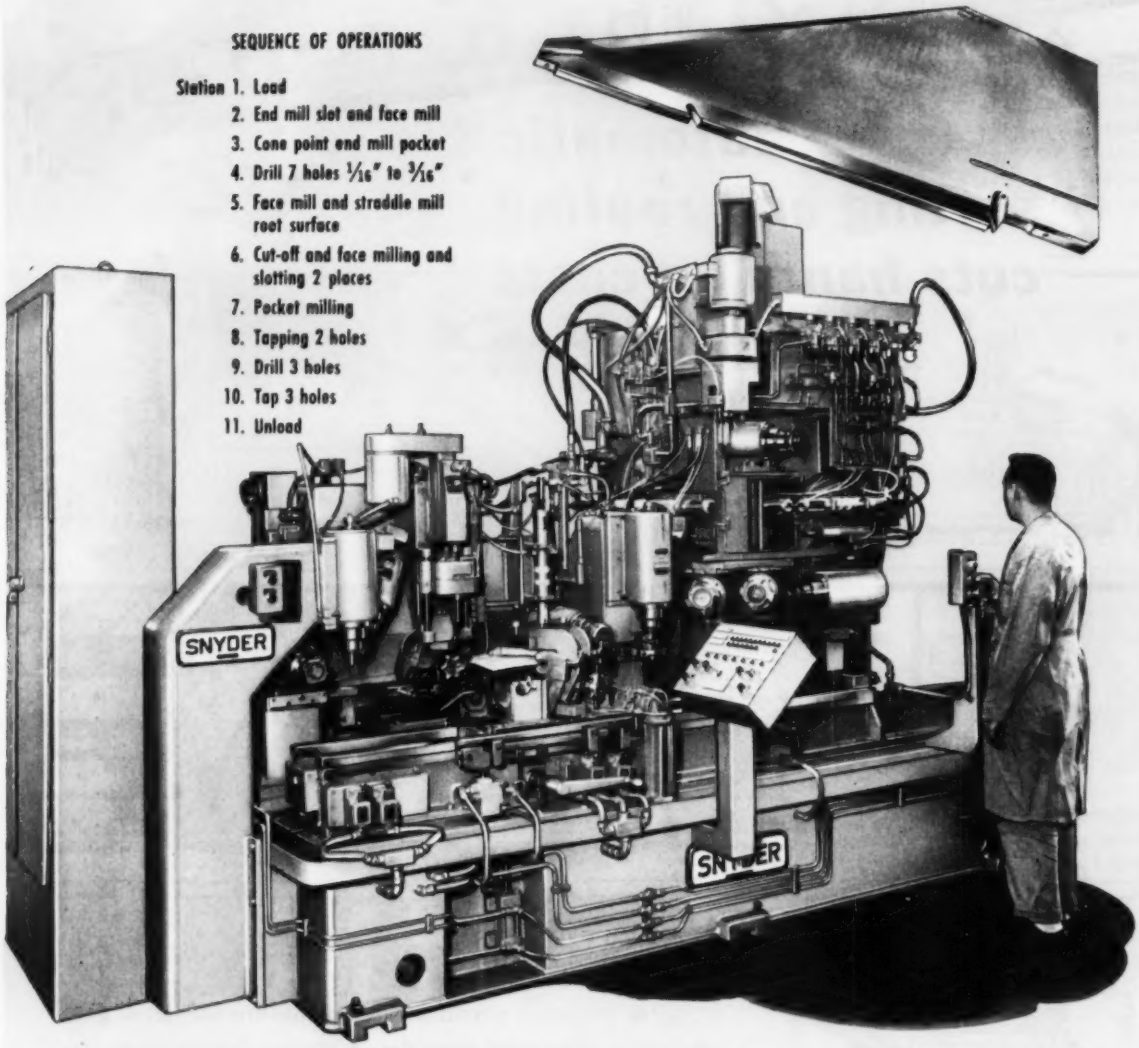
ENGINEERED CONVEYOR SYSTEMS • PALLET LOADERS AND UNLOADERS • VERTICAL LIFT CONVEYORS
ROLLER, BELT, APRON, PUSHER BAR, SPIRAL, AND SLAT CONVEYORS • PACKAGE HANDLING SPECIALTIES



Circle 684 on Page 19

**SEQUENCE OF OPERATIONS**

Station 1. Load
2. End mill slot and face mill
3. Cone point end mill pocket
4. Drill 7 holes 1/16" to 3/16"
5. Face mill and straddle mill root surface
6. Cut-off and face milling and slotting 2 places
7. Pocket milling
8. Tapping 2 holes
9. Drill 3 holes
10. Tap 3 holes
11. Unload




# COMPLEX MISSILE WING GETS 24 PRECISION OPERATIONS IN SPECIAL SNYDER PROGRAMMING TOOL

**at Martin Company's Baltimore Division**

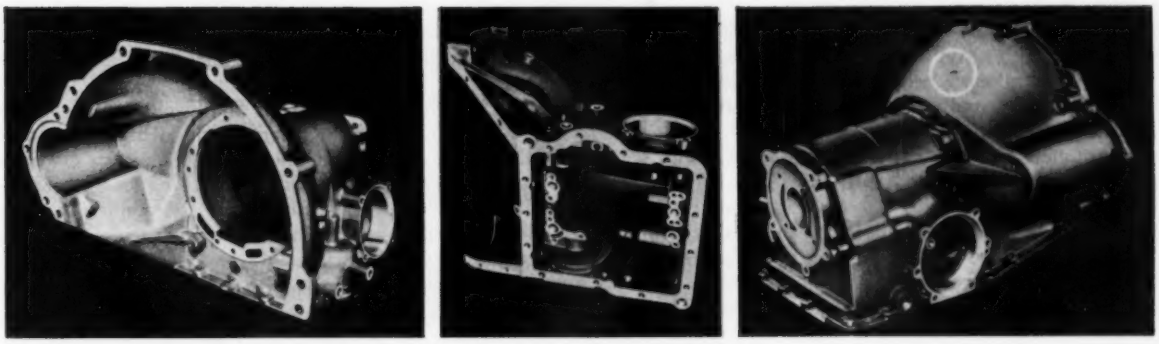
Production rate, tolerances and part configuration dictated the fundamental design concept of this exceptionally compact tool which has 11 stations and performs 24 operations.

The cycle can be automatic, semi-automatic or manual. Controls for multiple cycle operations are provided by utilizing basic circuits triggered by a programming control device.

**SNYDER**
**CORPORATION**
*(Formerly Snyder Tool & Engineering Company)*

**3400 E. LAFAYETTE—DETROIT 7, MICHIGAN**
**Phone: LO 7-0123**

By JAMES C. KEEBLER Managing Editor



Three views of an automatic transmission case. Holes in such parts are typically machined on transfer machines. Cross machine for this part handles two others, for the most part alike except for dimensions in hole patterns, and a fourth design that is considerably smaller.

# Versatility in Demand

"MAKE up your mind if any . . ." is one of those ancient sayings that can be misinterpreted several ways. One might infer a lack of mental facilities. Another might conclude that if there is something you want, set your mind to it. Still another message is to persuade one to choose between any alternatives.

As the automakers are currently reshuffling production facilities to meet unpredicted (and unpredictable) demands for compact cars, the need for versatile production equipment is brought more sharply into focus. Amid cries for standardization come countercries for flexibility. The only answer seems to be to standardize on flexibility.

Recently a top sales executive of a large machine tool builder was heard to speak of the building block standards as a big headache. The attitude expressed was that if these birds are so shot with the idea of interchangeable machine sections why can't you take the engine out of a Ford and put it in a Plymouth. Some critics feel that if Volkswagen and Renault consummated such an arrangement it would be offered by Detroit in a matter of time.

Although versatility may not be synonymous with indecision, the results might bear a marked similarity. The automobile and the machine tool are both capital goods and each reflects design considerations that are in demand in their respective marketplaces. The fact that your customer tells you he wants one thing and in turn buys something else is not only an inconsistency, it's a fact of life.

What per cent of the goods that flow to markets represents a switch of decision on the part of a customer is not reported by the Commerce Dept., but it can be observed that a lot of business is transacted as a result of the customer's single-mindedness wearing out before the vendor's merchandise. This brings us to the more modern adage: "Why make up your mind—it's not good for business!"

### Competitive Markets

On the one hand automation is seen as a way to beat foreign competition and on the other it can be seen making the competition keener. It has been called to our attention that companies making containers, match packs, and the like are not threatened by foreign competition because their production facilities are so highly automated that shipping costs play a major role in product sales price. The foreigner cannot afford to ship such goods to U. S. markets.

The domestic situation is so competitive that manufacturers of such products are building small automated plants in strategic market areas. Interestingly enough this brings other factors into prominence. Because a smaller plant serves a smaller volume market there is a need for more versatile production facilities that can be reset to handle orders for different sizes or designs.

Yes, Detroit too has moved into plants all around the country, but the circumstances of automation and the marketplace have not yet come to the place where models made out-of-state are at a serious competitive disadvantage. This too may come to pass.

### Achieve Flexibility

It was our privilege to participate in the ASTME Symposium: "Automation-Numerical Control" in Detroit at the Society's 28th Annual Meeting. Some of the comments in and about the papers delivered for that symposium are interesting in light of the foregoing commentary. "Areas in Which Automation is Useful" was presented by William Goeckel of Snyder Corp., and "Field Experiences with Automation" by Robert Read of Cross Co. Both of these men made clear points concerning the versatility of building block type transfer machines.

Goeckel indicated that flexibility features ". . . give transfer machines much lower obsolescence rates than is usually accorded them." He told of one transfer machine built to produce automotive intake manifolds in 1948 that is still in production today. It has been efficiently altered and rebuilt ten times since then to suit what often

were extensive design changes.

Read cited an instance where two transfer machines had been installed to machine automatic transmission cases. A "long" line was set up to run either *A*, *B*, or *C* parts. A "short" line to run only *A* parts. After installation *B* became the big quantity item and the short line was converted to handle that part only. Later the long line was modified to accommodate a fourth case, considerably smaller than the others. It was pointed out that these changeovers were accomplished in a short span of downtime for rebuilding because building-block construction, interchangeability, and flexibility features were engineered and built into the original equipment.

The paper by Wallace Brainard of Kearney and Trecker was ably handled in the meeting by their Russell Clegg. Brainard sees numerically controlled machines helping the "continuous production" industries by making test models and pilot productions, ". . . may well be the answer to maintaining spare parts for obsolete models . . . eventually reduce the cost of special production machines by becoming capable of making these machines." He sees numerical control assisting in the automation of the decentralized plants of the future:

"A railroad can transport raw materials at less cost than any transportation method can handle the products made from the materials. With our production facilities concentrated in a few industrial centers. we transport the finished product over long distances, and the raw material over short distances. If we can reverse this, vast amounts of money will be saved.

"As the costs of lower-production rates become competitive with existing mass-production methods through the use of numerical control, we will see a decentralization of manufacturing with a resulting reduction in transportation costs. The flexibility of numerically controlled manufacturing and the availability of superior labor in more livable areas may well influence a trend to still higher standards of living."

Charles Chapman, manufacturing engineer of General Electric Flight Propulsion Div., was the user on the panel. His outfit sports five different numerical control systems on fourteen machine installations. They are standardizing on this method of achieving flexibility.

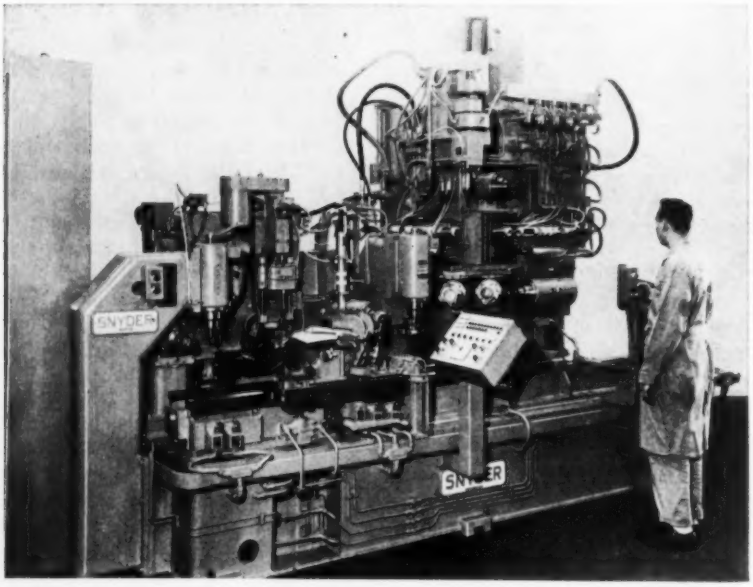
### What Tomorrow Brings

"What Is the Future of Automation and Numerical Control?" was discussed by Carl Stugard of the Cincinnati Milling Machine Co. The pressures of evolution are seen to be pushing us in several directions. Stugard sees demands for mass-produced goods leading to more specialized, single-purpose machinery. At the same time he observes more demands for products made in small lots that would seem to call for general-purpose highly versatile machinery. His remarks concerning future combinations of fixed-program and selectable - program automation are particularly appropriate:

"The possibilities inherent in combination machines are especially attractive. Transfer machines in which some stations have fixed programs and others have variable programs controlled by tape are easily capable of being built today and a good many of them will be seen in the future. There is a good chance that these machines may be devoted less to metal cutting than to alternate methods of creating metal shapes, for the simple reason that the possibilities of speeding up the alternatives are greater than the possibilities of speeding up cutting itself."

Although it may appear that automakers are having trouble making up their minds as to whether they want stripped-down single-purpose machine tools or chrome-plated versatile production equipment, it is clear that they are looking for ways to get better manufacturing facilities for less money. This single-mindedness may be an opening for Carl Stugard's wish that the machine tool builders could price and sell improvements such as numerical control on the basis of savings in tooling and time instead of the basis of cost to make the machine.

To do this would require some reorienting on the part of the sellers as well as the buyers. The emphasis would have to come off selling a machine that it is hoped the customer will find a use for. Strong effort would need to be placed on providing the prospect a manufacturing engineering analysis to show the savings that can be achieved by a proposed new installation. The question: "Will you pay me so much if I can save you such an amount?" would be inherent in such transactions and more equipment would be sold to supply the versatility that is in demand today.

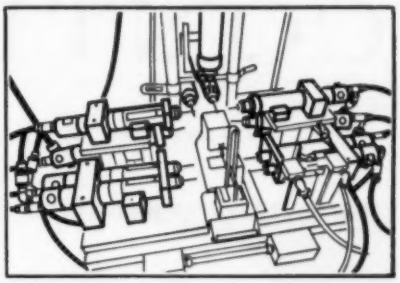



Snyder machine for milling, drilling, and tapping missile wings is like a transfer machine in that it has multiple stations in line and is built up of welded bases, arms and columns. Single fixture indexes part successively to each of five positions. Some machining operations are carried out while part is being indexed.

# ARO IS YOUR ANSWER— LOW COST *Automation!*

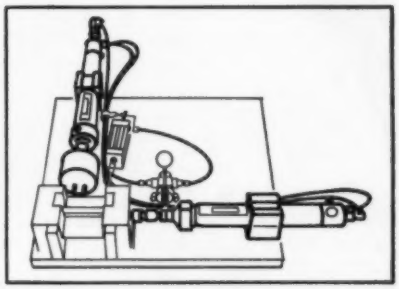
## DRILL 3,000 per hour

Set up any number of Aro Self-Feed Drills in single fixture, then drill up to 3,000 holes per hour automatically. Capacities from $\frac{1}{16}$" to $\frac{1}{2}$" . . . speeds from 500 to 20,000 rpm . . . stroke lengths from $\frac{3}{8}$" to 6". Use any combination of types and speeds, mount drills in any position.



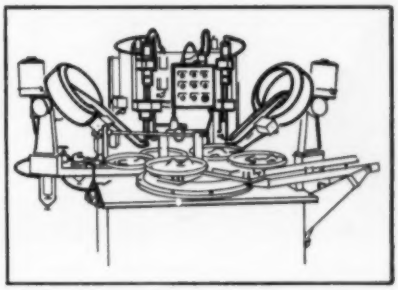
## TAP 2,400 per hour

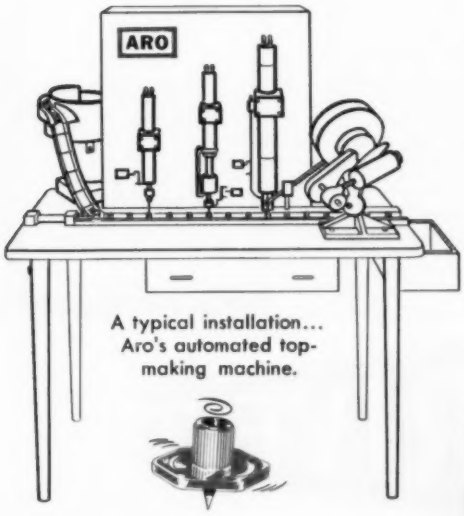
Combine your drilling and tapping operations in one fixture and eliminate costly handling. Aro Self-Feed Tappers have capacities up to ¼"-20 in mild steel, or larger holes in softer materials. Speeds of 500, 900, 1,450 and 2,700 rpm. Stroke lengths up to 1½". Accessories for precision depth.



## FASTEN 3,000 per hour

Go automatic on your threaded-fastener operations with Aro Self-Feed Screwdrivers-Nutsetters. Standard range of speeds for the most commonly specified screw sizes. Uniform torque settings held within close limits. All models available with precision ball-type clutch.






A typical installation... Aro's automated top-making machine.

## *LET ARO TELL YOU HOW—*

Without obligation, give us brief details of any drilling, tapping or fastening job which you would like to automate . . . your blueprint would be helpful. We will send our recommendations or have a representative call on you.

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Offices in All Principal Cities



Circle 686 on Page 19

*FEATURED IN CONTROL SYSTEMS OF MISSILE PROGRAM!*

# New FLOW CONTROL VALVES

pressure compensated

From RIVETT

Rivett Hydraulic Flow Control Valves are *now* being introduced to the trade after four years of thorough field testing in advanced applications for both government and industry. These valves may be used as ordinary "meter in," "meter out," or "bleed off" types of compensated flow control valves by keeping the bypass port plugged in the subplate, and piping the "inlet" and "outlet" ports as desired. This usage means excess oil is spilled over a relief valve so pump is always at full horsepower.

On some meter-in circuits, with the "bypass" port piped to tank, the "inlet" and "outlet" can be piped as above, but any excess oil fed to the valve will flow to tank. As long as the fluid motor or cylinder is working at less pressure than system relief valve setting, the Rivett 3-port flow control will maintain oil flow to the work as set, the bypass port will flow excess oil to tank at the work pressure, and therefore the pump is using horsepower only at the rate determined by work requirements.

**FEATURES**

**1**
Knife edge orifice positively assures consistently uniform low flow; and minimizes change of flow when change of fluid temperature occurs.

**2**
No drain connection required because special pressure balanced Teflon seals are used.

**3**
Maximum flow capacities up to 125 G.P.M. in 1¼" size are standard.

**4**
Valves are usable as two port and three port models.

**5**
Vernier knob has provision for safety lock wiring.

**6**
Valves are available with return free-flow check.

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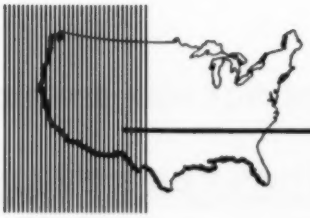
Dept. AU-6, Brighton 35, Boston, Mass.
*The Better You Know Hydraulics — The Better You Like*

RIVETT


Circle 687 on Page 19



# western trends

By PATT PATTERSON
Los Angeles, Calif.

One of the first full-scale chemical processes to be controlled by a computer is located at the Calvert City, Ky., plant of B. F. Goodrich Chemical Co. This view shows the control room for the closed-loop control of a vinyl chloride monomer plant. In the foreground is a Thompson-Ramo-Wooldridge Products Co. RW-300 computer which scans and logs data and controls the process. The company is planning to extend the system to logging and control of an adjacent acrylonitrile plant without further addition of equipment. Original estimates indicated that the installation would pay off in 3 to 4 years from control of the vinyl chloride plant alone.

## Comparing Notes

COMPUTER control of processes is one area of automation where much has been promised for the future but only a few concrete accomplishments are on the books at the present. Progress has been made in this area, but it has been limited mainly to the chemical and petroleum processing industries.

In April, representatives of these industries got together in Los Angeles at the 2nd Symposium for Pilot Plant Automation to compare notes and to find out just where the state of art stands at the present time. The event was sponsored by process control equipment builders — Consolidated Systems Corp.; Control Systems Div., Daystrom Inc.; and Thompson-Ramo-Wooldridge Products Co.—but the user companies carried the ball as far as organizing the meetings and getting the facts in the record.

Attending the 2-day affair were over 120 research and engineering leaders representing more than 60 chemical, petrochemical, and petroleum refining companies interested in automating processes. The list of participants reads like a Who's Who of these industries for it included such well-known companies as Texaco, Gulf, Socony Mobil, Standard Oil Co. of Ohio, Shell, Richfield, Humble Oil, Phillips Petroleum, Monsanto Chemical, Cities Service, E. I. du Pont, Celanese Corp., Allied Chemical, American Cyanamid, Union Carbide, U. S. Rubber Co., B. F. Goodrich, Autonetics, Aerojet-General, International Business Machines Corp., and Fluor Corp.

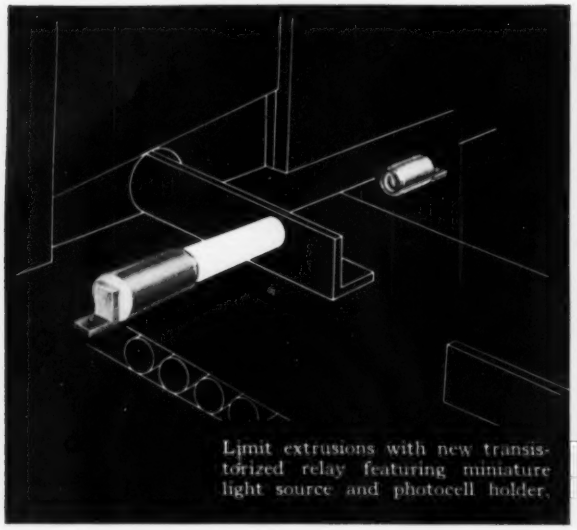
The symposium was divided into panel sessions covering four aspects of computer control that were considered of most interest to users and potential users of this and other automation equipment in pilot plants. These topics included the status of equipment and the state of the art, technical and economic objectives, case histories of existing installations, and the effect of automation on research strategy.

A number of generalizations can be made from the opinions expressed at the symposium. Results from initial installations indicate that the use of computers in pilot plants makes possible more complete testing and control, more rapid data gathering and processing, and consequently more sophisticated design techniques for full-scale plants. However, there are some widely differing opinions about the economic value to be derived from computer control of pilot plants. With many millions of dollars being spent on research and development today, anything which improves the productivity of this effort should pay real dividends. Benefits from pilot plant automation will not show up as reduced annual development costs, but instead will appear as earlier reduction to commercial practice of the concepts developed and as the ability of the same number of technical people to work on more problems.

Some engineers believe that benefits attributable to computer control should be carefully identified as such, and these benefits should be used to justify the installation. Others feel that the application of computers to pilot plant control should be considered as an engineering research project in its own right. And still others tend to believe that too much time and money are being spent in trying to justify the use of these tools compared to the time and money frequently expended in making decisions affecting much greater financial commitments which often have less potential gain.

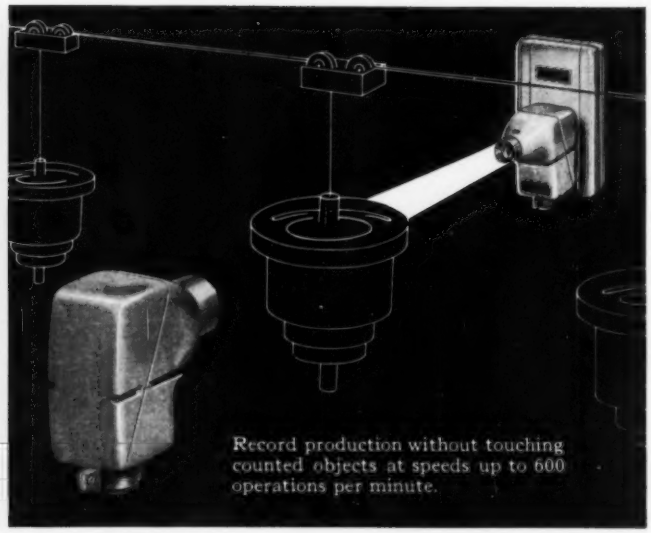
**FOR QUALITY . . . PRODUCTIVITY . . . PROFIT . . . MODERNIZE WITH GENERAL ELECTRIC**

## LIMITING



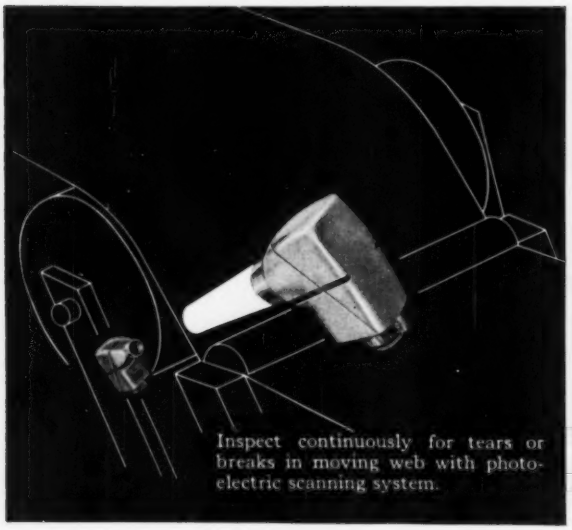
Limit extrusions with new transistorized relay featuring miniature light source and photocell holder.

## COUNTING



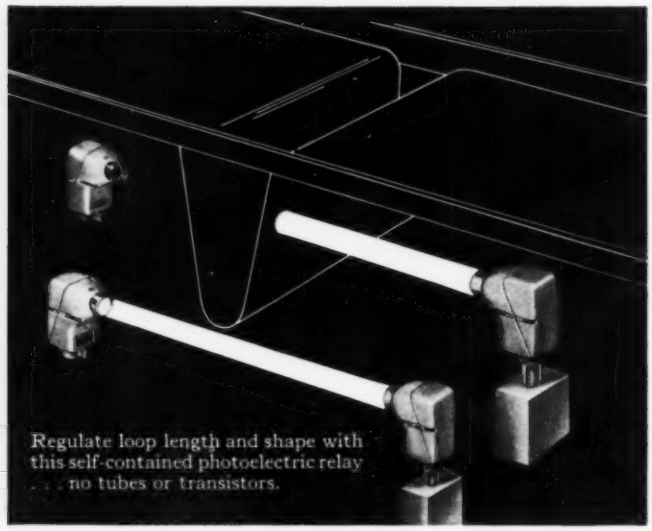
Record production without touching counted objects at speeds up to 600 operations per minute.

## DETECTING



Inspect continuously for tears or breaks in moving web with photoelectric scanning system.

## CONTROLLING



Regulate loop length and shape with this self-contained photoelectric relay . . . no tubes or transistors.

**A COMPLETE LINE OF GENERAL ELECTRIC CONTROL DEVICES**

**Photoelectric controls**
- General-purpose
- High-speed
- Long-distance

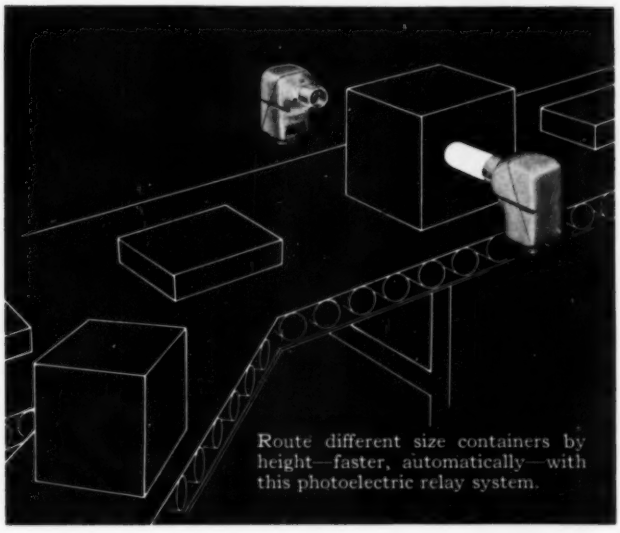
**Electronic devices**
- Timers
- Resistance-sensitive relays
- Voltage-sensitive relays

**Photoelectric systems**
- Smoke-density indicators
- Side-register controls
- Cut-off register controls

CONTROLS FOR AUTOMATION

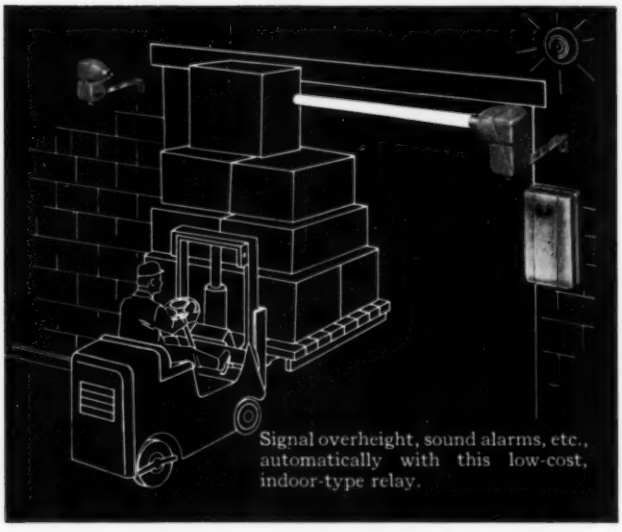
PHOTOELECTRIC CONTROLS

# SORTING



Route different size containers by height—faster, automatically—with this photoelectric relay system.

# SIGNALLING



Signal overheight, sound alarms, etc., automatically with this low-cost, indoor-type relay.

**Switching . . . inspecting . . . counting . . . diverting . . . sorting . . . controlling.** These are but a few of the *hundreds* of applications where General Electric photoelectric controls are helping our customers move closer to the benefits of automation—increased productivity, lower costs, higher quality.

Users are finding *new* ways to fit General Electric photoelectric devices into their production processes every day . . . for good reasons: These versatile G-E controls are designed for heavy-duty industrial use. They're easy to install, and require virtually no maintenance. They are highly dependable throughout a long operating life. In fact, General Electric photoelectric controls feature lamps with life expectancy of 10,000 hours—more than a year of round-the-clock operation!

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General Electric photoelectric and electronic devices carry a standard one-year warranty for your protection. And, your order for standard catalog devices is filled immediately from one of six regional warehouses. Also, replacement parts are warehouse-stocked, too, for your convenience and protection.

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**SEND TODAY FOR FREE CATALOG**

**General Electric Co., Section C793-02**
**Schenectady 5, New York**

Please send me a copy of the G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

**Name** _____

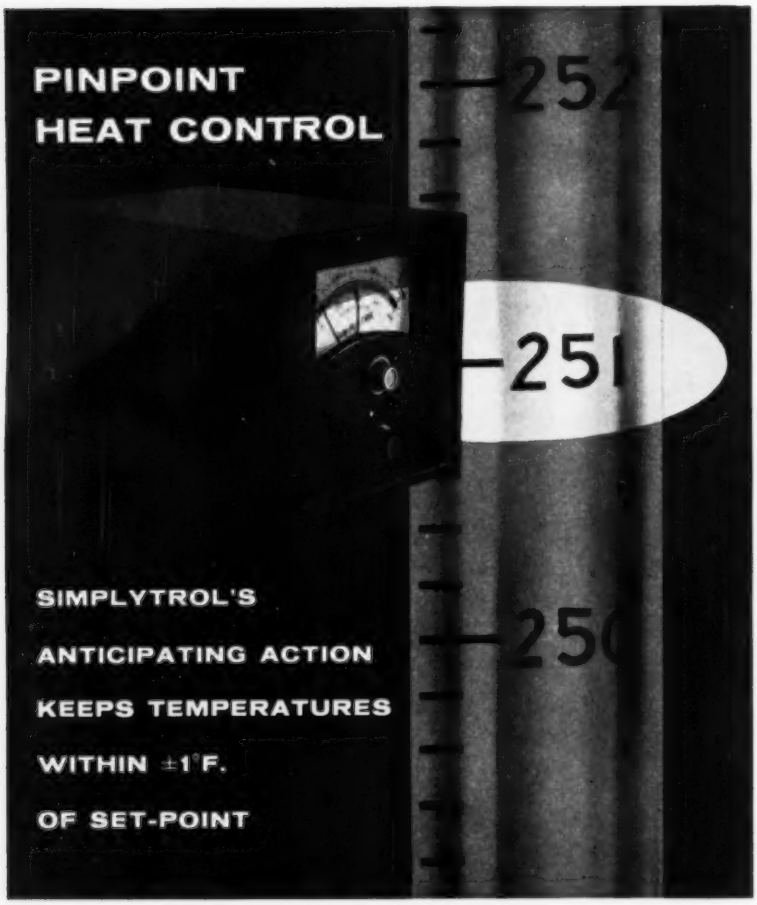
**Company** _____

**Address** _____

**City** _____ **State** _____

*Progress Is Our Most Important Product*

GENERAL ELECTRIC




Temperature controlled by the Simplytrol behaves the way you want it to. It doesn't soar or sag. It can't. Simplytrol's special time-proportioning anticipating circuit senses temperature build-ups, and modifies the heat cycle well before over-shoots can occur. Control consistently follows the straight-and-narrow . . . within ±1°F. of set-point.

For all its precise performance, Simplytrol is a surprisingly uncomplicated device. The A.P.I. meter-relay (good for at least ten-million decisive "make-break" operations) is its primary component. Actuated directly from the thermocouple input signal, the meter-relay needs no amplifying circuits or vacuum tubes. Consequently, Simplytrol's operation is exceptionally stable; there is no drift or signal distortion.

There are three basic Simplytrol models available in thirty ranges from −400°F. to 3000°F., and packaged in a variety of mounting cases. One could be just the temperature controller you've been looking for. All are fully described in new Bulletin 108 . . . yours for the asking.

api **ASSEMBLY PRODUCTS, INC.**
**Chesterland, 27, Ohio**

An interesting development was the increasing number of user companies who have installed or are planning to install computer control directly in full scale operating plants —completely bypassing the pilot plant. The reasoning behind this fact was that there were already too many variables in pilot plant operation. The effects and economies of computer control can be adequately determined in installations where a process is established, and a satisfactory end product is made.

The concept of computer control in fields other than chemical processing is a long way from being realized. The major lack seems to be in sensing devices rather than in the ability to program a computer to recognize required operating changes and provide proper controlling impulses. Transducers for solids processing have not been developed to a stage of practical operation, and the concept of computer control is being held back by the requirements for adequate and accurate transfer and positioning techniques. However, it is entirely within the realm of possibility for a factory of the future to be planned with complete computer control of all work flow, probably integrated with numerical control of individual pieces of manufacturing equipment.

In the chemical process industries, the problem of transfer and positioning is minor since the products involved are primarily liquids and gases which can be made to flow through pipes and ducts in proper concentrations. Even here, computer control is a relatively new and isolated phenomenon for there are only a handful of on-line computer control installations in existence. Most of these setups are in pilot plants or small units of larger installations and were installed to determine the effects and economies produced by computer control.

The commodity of time in industry is precious. If computer control can save time, its cost will probably be justified many times over. The question is not whether the chemical processing industries—or any industry—should automate, for automation is already a necessity. The question is, how quickly and how fast shall they automate? The people who have the greatest difficulty in applying automation are often the ones who have the most to gain.


Circle 689 on Page 19
Circle 690 on Page 19→

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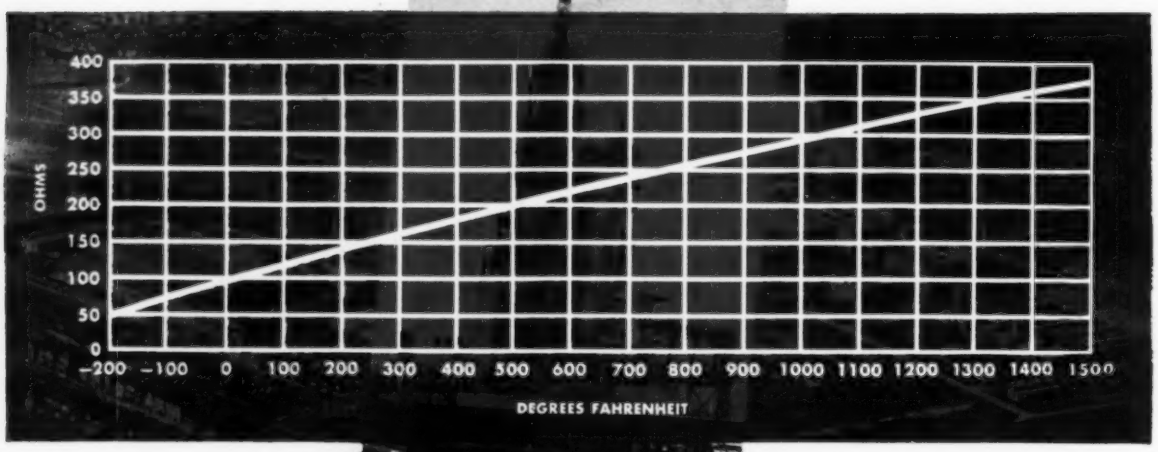


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# Goals and Guarantees

"Hit-or-miss technical development is not adequate in today's conditions. In the beginning, many a small company can justify a technical research group only in terms of quality control. But, in the long run, staying in business may hinge on technical development." With these words, a recent Small Business Administration publication keynotes some pertinent facts on getting into research. Pointedly this business aid comments that quality control is necessary and valuable in production but research may be even more important. Especially emphasized is that phase of research directed toward improving production processes.

A key factor in planning such manufacturing research and machine development is the advantageous tax treatment available. Under Section 174 of the IRS Code, engineering research and experimentation expenditures may be handled by any one of three methods: 1. Charge the expenditure against income for the year in which it was paid or incurred; 2. Defer charges against future income starting amortization when benefits are first realized from the equipment and ranging up to five years; 3. Charge the amounts as capital expenditures. Equipment builders as well as users should neither neglect the opportunities available nor overlook the restrictions imposed by the new regulations.

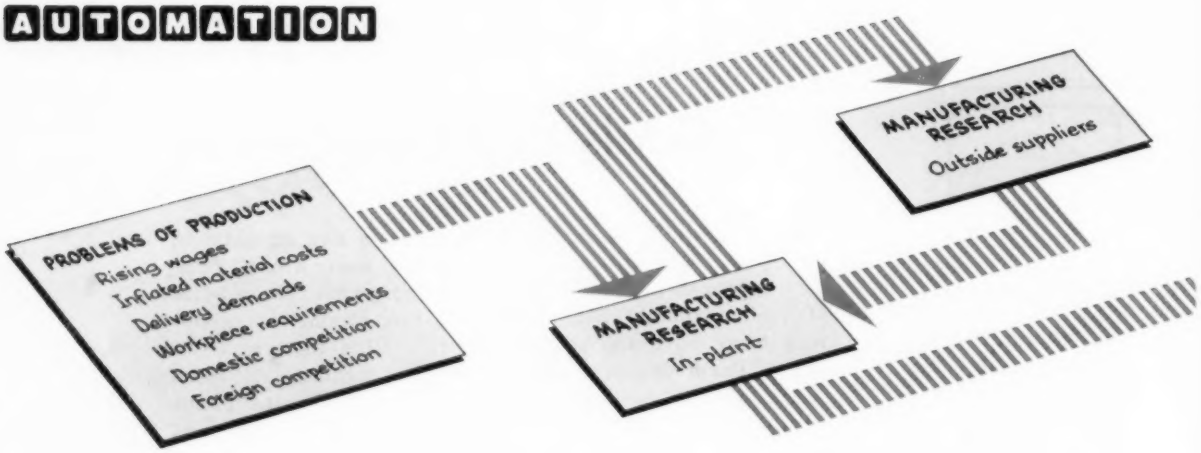
Some important considerations are involved in decisions involving research expenditures, however, and must be seriously evaluated. Accurate determination of equipment useful life is a critical factor in selecting the proper method. Actual equipment construction costs such as labor, materials, etc., must be carefully segregated from engineering research costs not directly attributable to the machinery itself. Most important, where performance guarantees are exacted and the taxpayer takes no risk, no portion of an expenditure can be deducted on a research or experimental basis. Here the difference between engineering goals and performance guarantees must be adequately recognized so as to avoid limiting the assignment of such investments as deductible expenses, as specified in the IRS Code.

Well thought out policy and planning can make manufacturing research programs effective and highly profitable in the years ahead. Future manufacturing leadership will depend on it.

Clearly, as the need for automation progresses, long-range manufacturing research becomes more and more imperative. And, it is important to recognize that effective manufacturing research does not evolve of itself precisely as needed. Neither can it be expected to come completely free through the generosity of equipment vendors. It is a well planned investment in the future.

PUBLISHER-EDITOR

AUTOMATION




# MANUFACTURING RESEARCH

## PHILOSOPHICAL AND

By ROGER W. BOLZ,
Publisher-Editor

**Why are progressive manufacturing concerns putting increased emphasis on research and development of production processes and equipment? What policies are they using to determine where costs of such manufacturing research should be**

MANUFACTURING INDUSTRIES have changed radically in general character over the past decade. Under the impact of automation few of the old parameters for decision making remain valid today. Not the least of those requiring fresh approaches are capital equipment acquisition, equipment engineering, manufacturing research, industrial accounting procedures, and depreciation.

Perhaps most significant among the changes in the industrial picture is the dynamic rise in manufacturing engineering research. One lesson that has been learned through bitter experience in critical areas is that few industries can remain competitive without adequate investment in manufacturing research. No other factor is more potent in establishing the profit or loss position of any company.

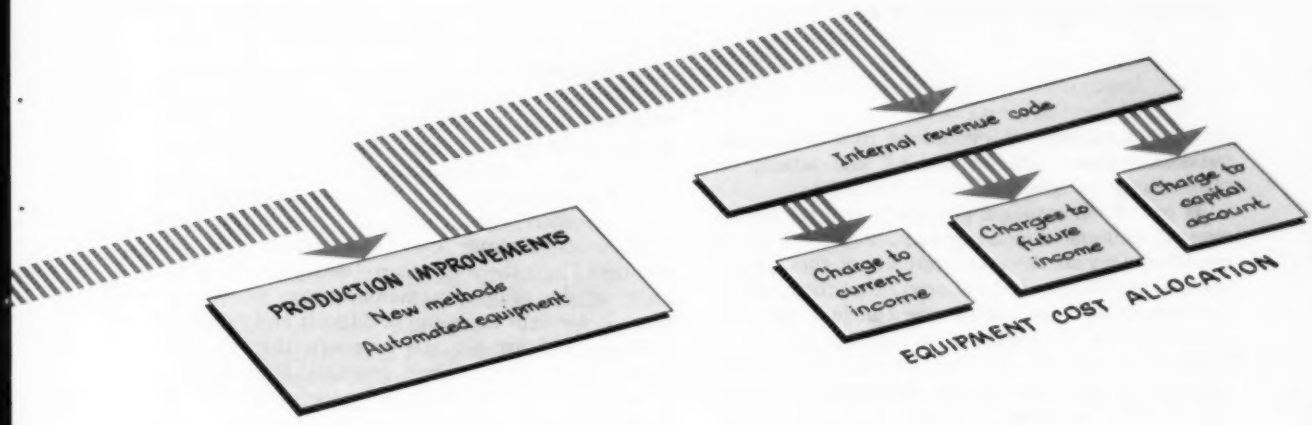
Although most manufacturers pay for such research one way or another, proof of the fact that many already recognize the value of manufacturing research enough to invest consistently is plentiful. More than 25 per cent of manufacturers today actually have regular staffs devoting time to this endeavor. Many more engage in such activity in less formal manner. The critical factor of note here is that in no other way will it be possible to combat inflation, rising wages, and competitive forces, both local and foreign.

The end result of manufacturing research is manufacturing equipment to carry out the newly developed or advanced methods of manufacture. Today this equipment is almost invariably of automated character, and here again the part played by research and engineering assumes a major role. Manufacturing engineering plays a dual role in development of improved lower-cost production processes and in development of equipment to carry out these processes.

In the management of modern day enterprises, the key part played by manufacturing engineering requires recognition from a technical standpoint first but, equally important, also from a capital acquisition standpoint. In the throes of the changes taking place it is all too easy for the engineering phase to become lost in clinging to past practices.

Not only is it desirable today to establish a formal group within the company or other means for development of new methods and machinery but it is also desirable to establish adequate means for handling such research and engineering costs. Adequate guideposts are already on hand and used widely enough to provide proof of advisability.

In evaluating your position for the coming decade




# AND CAPITAL COSTS

## PRACTICAL CONSIDERATIONS FOR MANAGEMENT

**charged? How do income tax provisions and depreciation plans affect these considerations? Comments from manufacturing leaders throughout American industry form the basis for this discussion of these related topics.**

it is desirable to raise a few questions: Is it safe businesswise to wait until competition forces the issue or is it better to be prepared with improved methods to maintain your profit ratio? Can you afford to take the attitude that someone else can pay for engineering your new automated equipment? Is it good business to bury equipment engineering costs in capital costs and hope for better depreciation allowances? Might not manufacturing engineering costs—largely research where automated equipment is concerned—provide a better financial picture if handled separately as they should be? A look at some of today's thinking on these subjects will offer some positive guideposts for action.

### ▶ Manufacturing Research

Few other investments in manufacturing operations can equal the profits possible by means of new manufacturing techniques or innovations in production methods. Concentration of basic and applied research unfortunately has been primarily in terms of end products, not processes. In the scramble for new products the real values of new methods and equipment are easily overlooked.

This tendency to overlook the research and engineering phase of manufacturing has been emphasized by Eliot Janeway[1] with this comment: "In recent years, the kind of engineering skills that set up production and make it tick have tended to get lost in the shuffle between the scientists at one extreme and labor at the other."

Fruitful research in manufacturing requires a thorough, continuing long-range program solidly backed by top management. Seldom can quick results be expected. In commenting on the value of superior research and development programs directed toward improved facilities and equipment, Mr. J. W. Keener, president and chief executive officer, B. F. Goodrich Co., says: ". . . after a new capital facility is completed, it takes six months to two years for the plant to reach a profitable level of operation. Eleven new plants or expansions that have not yet made their contributions to B. F. Goodrich net income or to unconsolidated company equity growth should start producing income at conservative levels this year. Another six should become profitable in 1961 and four more in 1962 to 1964."

In altogether too many instances it appears that industry more or less expects production research to take place automatically when it comes time to replace equipment or tool up a new product. A common fallacy appears to be that all that is needed

[1]References are tabulated at end of article.

is a large number of quotations from equipment builders, without first researching and setting up rather complete specifications.[2]

As one works manager puts it: ". . . if we are interested in some new equipment, for instance, we would contact all the manufacturers of this type of equipment. We would fully expect that these manufacturers in their quotations would include their engineering time to work out or develop systems or methods for our use. In such a case, the company that receives the order for this equipment is the one that is then reimbursed for the engineering time. The other manufacturers must charge this out as an ordinary company expense . . .

"In this age of automation to remain competitive we must be sure that we are buying the best equipment possible in order to be able to produce in the least time. Unless suppliers of equipment analyze tooling, methods, etc., thoroughly before quoting, we could never be sure that we were getting the best deal."

However, owing to the volume of such engineering work, equipment builders are finding it difficult to absorb such costs and either must decline to bid or shortcut the effort involved. D. E. Moat, vice president-marketing of Leeds & Northrup Co. indicates the problem this way: "With the increasing complexity of the technical requirements today we have been forced to recognize that special engineering is a part of the production costs on special equipment. All manufacturers who are called upon to produce special equipment are moving in the direction of including these engineering costs as direct costs of sales rather than dealing with them through the applied overhead route. I believe that this is essential if we are to obtain accurate costs on special jobs, particularly when the amount of engineering will vary from job to job. At least this is the preferred procedure from the standpoint of the equipment manufacturer."

Another way of viewing the situation creates cause for real concern. Will a failure to recognize research and development costs in manufacturing processes result in a drying up of valuable sources? There is good reason and ample evidence to conclude it will. In commenting on the problem, G. E. Seavoy, vice president of Whiting Corp. has this pertinent comment: "An example of this is an inquiry recently received for highly automated equipment in which pushbutton control was specified in a broad sense only as a requirement. Normally such equipment, nonautomated, would sell for $45,000 to $50,000. To do what the customer wanted would raise the selling price to $100,000 to $110,000. In order to make a safe estimate, over 3,000 hours of presale engineering would be required. At $6.00 per hour, this would represent gambling $18,000 in the preparation of a quotation with no assurance of getting the order.

"All this served, however, to formulate a policy with regard to situations like this, namely, that when the inquiry indicates that engineering will be relatively excessive, that the risks involved are accordingly abnormal, that it is border line in other aspects, either negotiate on a cost-plus-fixed-fee basis before making a quotation or else refuse to quote. Furthermore as equipment builders we would be uninterested in selling the engineering unless there were a commitment to buy the physical machinery."

In the same general vein, J. J. Jaeger, president of Pratt & Whitney Co. Inc., comments in this manner: ". . . there is a correlated problem which many of the equipment manufacturers now recognize. It becomes increasingly difficult and expensive to study and arrange the proposals that are now being requested for many projects. It becomes a great question in my mind how much longer it will be possible to provide these quotations without some charge to the individual requesting these proposals. It appears in many cases that requests of this sort are being made for the basic information of the individual and in other cases merely to support another proposal that has already been basically accepted. I think this places an unfair burden on the manufacturer of equipment and it obviously must reflect in his average sales price of all equipments. I think you recognize that in like manner the direct engineering that is done on an order might well be considered a separate research expense; so too, might the proposal studies, which are required in many cases be viewable as a current expense rather than capitalized as a portion of the capitalized investment."

Regardless of whether activity, that of necessity today must be classified as engineering research, is carried out in-plant or obtained outside, it must be bought. There, of course, can be no "free" engineering realistically speaking. Good management demands recognition of both the urgent necessity for manufacturing research and the proper accounting procedures with which to handle it as a legitimate company expense.

### A Plan for Equipment Contracting

Because equipment can vary widely in character and complexity, the amount of special engineering and/or manufacturing research involved also varies. To properly handle various types of jobs, typical contracts are arranged to suit. As a guide, Glenn A. Barth, president, Barth Corp., submits this system for consideration:

1. **Firm Price—Design and Build:** Applies mainly to simple devices and simple special machines. If a firm price is required by the customer, sketches are made by Design and priced by Estimating.

2. **Firm Price Design—Approximate Price Build:** Applies to moderately simple equipment. Procedure same as for Item 1 except firm price on build is reached *after* designs are completed and approved by customer.

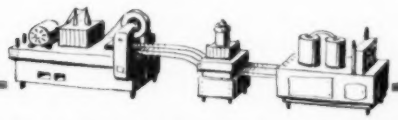
3. **Firm Price Design—No Price on Build:** Applies to relatively complex equipment. Firm price on build is reached *after* completion of design work.

## ▶ Capitalize or Expense?

In recognizing all basic research, whether for a particular machine development or a complete line installation, it appears to be rather commonplace to expense such costs when development is carried on in-plant. In commenting on this phase, the general practice is pointed up by Edward N. Evans, president of Cambridge Wire Cloth Co.: "We are most unfortunate in our type of manufacturing because there aren't standard spiraling machines obtainable to manufacture woven wire conveyor belts. Since these machines have to be made in our machine shop, we naturally find it necessary to do our own engineering and designing, which is handled as current manufacturing research expense."

Along these same lines is this statement from Kurt Hesdoerffer, administrator, automation and equipment development, Radio Corp. of America: "It is the practice throughout RCA to budget engineering, development and 'debugging' and run-in costs as overhead and to distribute these charges together with other overhead expenses throughout the division or department. Successful developments are capitalized on the basis of their reproductive cost."

That the research involved today in developing modern processing facilities is indeed recognized is evidenced by this comment from the president of another large concern: "Today an extraordinary amount of research and engineering expense, both on the part of the purchaser in making preliminary studies of the need for such machinery and on the part of the supplier in designing and constructing special purpose machinery, is incurred. In many cases the automation machinery supply people perform a segment of research and engineering development for the customer."



**4. Approximate Price Design—Approximate Price Build:** This applies to complex equipment. Type of contract usually starts with customer authorization of initial design expenditures, usually a percentage of design price. Firm design price is reached during this design phase. Firm price on build is reached *after* completion of design work.

**5. Not to Exceed Initial Price Design:** This contract is established on difficult and extremely complex equipment. It may include such phrases as "investigate the problem of" or "determine the feasibility of." Contract will terminate if project is not practical. If it is deemed practical, the stages that follow are: (a) Approximate Design Cost; (b) Firm Design Cost; (c) Firm Build Cost.

**6. Time and Material—Design and Build:** This is for subcontract work. Here complete details of the contract must be set up: (a) Total Contract Value; (b) Design and Build Rates; (c) Material and Subcontract Markup; (d) Items Classifying Direct Labor; (e) Liaison Engineering Service Charge; (f) Terms.

Studying engineering research costs from a general accounting standpoint provides a practical approach to the problem. The "Accountants' Handbook"[3] presents the basic considerations: "Development costs may be incurred in large amounts in connection with some special department, project, or process, long after the business as a whole has been launched. Ideally such costs should be collected in an appropriately labeled account and treated as an asset until such time as it becomes proper to amortize the investment against the revenues realized, or, in the event that the result is unsatisfactory, to write off the item as a loss.

"The foregoing comments may be applied to costs of experimentation, testing and the like. Where such costs represent a regular activity of the business, necessary to maintain the position of the enterprise, they may well be treated as current charges; where such costs are incurred on a large scale in connection with some special project or undertaking, capitalization is not improper. In income tax administration, cases have arisen in which costs of developing patents and special processes have been excluded from current charges to income."

In following out such proposed procedure, the question often arises as to the practical aspects. Can such flexibility of handling costs be used? Is it acceptable? R. J. Van Dame, controller, Lincoln Electric Co., has this to say: "As you are aware, Section 174 of the Internal Revenue Code of 1954 permits a taxpayer to treat research expenditures, paid or incurred by him during a taxable year in connection with his business, as expenses which are not chargeable to his capital account. It has been our practice to deduct such charges from taxable income and, barring any change in the Code, we would expect to continue this policy.

"On the other hand, if we were to place an order for some special machinery, involving a substantial amount of unusual engineering expense by the producer thereof, we would undoubtedly request an invoicing apart from the amount of machinery billing, because we feel that such engineering expense should be treated as a current manufacturing research expense rather than a capital investment."

In spite of many comments to the contrary, Section 174 of the Internal Revenue Code of 1954 permits a selection of any of three basic methods for handling engineering and research costs in the manner most suitable.[4] These alternates are: 1. Charge the expenditures against income for the year in which it was paid or incurred. 2. Defer the charges against future income starting amortization when benefits are first realized from the equipment and ranging up to five years. 3. Charge the amounts expended to regular capital account.

Regulation §1.174 points out that Section 174 of the Code applies only to specific areas of research and experimentation and pretty clearly outlines the application: ". . . provisions of this section apply not only to costs paid or incurred by the taxpayer for research or experimentation undertaken directly by him but also to expenditures paid or incurred

for research or experimentation carried on in his behalf by another person or organization (such as a research institute, foundation, engineering company, or similar contractor) . . ."

Some important considerations are involved in decisions concerning research expenditures, however, and must be seriously evaluated. Accurate determination of useful equipment life is a critical factor in selecting the proper method. Actual equipment construction costs such as labor, materials, etc., must be carefully segregated from the research, engineering, and experimentation costs not directly attributable to the machinery itself (see box). But, most important in the entire consideration is the risk involved. Where performance guarantees are exacted and, in fact, the taxpayer takes no risk, no portion of the expenditure can be deducted on a research or experimental basis.

Here, the buyer of equipment must be careful to understand the difference between engineering goals and performance guarantees in order to avoid limiting the assignment of such investments as deductible expenses: "No deduction will be allowed if the taxpayer purchases another's product under a performance guarantee (whether express, implied, or imposed by local law) unless the guarantee is limited, to engineering specifications or otherwise, in such a way that economic utility is not taken into account . . . Similarly, no deductible expense is incurred if a taxpayer enters into a contract for the construction of a new type of chemical processing plant under a turn-key contract guaranteeing a given annual production and a given consumption of raw material and fuel per unit. On the other hand, if the contract contained no guarantee of quality of production and of quantity of units in relation to consumption of raw material and fuel, and if real doubt existed as to the capabilities of the process, expenses for research or experimentation under the contract are at the taxpayer's risk and are deductible under section 174(a)."

Discussion of this general problem with top management across industry indicates that practical use of these methods for handling such legitimate research costs is being made. Typical of such comment is that of Harris Zeitzew, director, manufacturing administrative department, Capitol Records Inc.: "We believe that developmental engineering costs should be treated as current expenses. Under present tax laws, we are authorized to take deduction for these expenses on a current basis, without being forced to capitalize any portion of such expenses. We feel that this policy should be continued, since we are securing an immediate tax advantage.

"However, in the case of developmental engineering projects out of which some usable piece of equipment is finally developed for plant use, we believe that the equitable procedure would be to have the equipment appraised at the time of completion. The appraised value would include only those costs that would be incurred in the manufacture of a duplicate of the equipment. We would then be in a position to charge our capital equipment account this amount, and could then credit our engineering development cost account. The excess cost above the actual amount capitalized would remain as a tax deduction."

Another strong case is made by B. F. Butts, vice president-production, Cinch Mfg. Co.: "Specifically, we at Cinch Mfg. Co. have invested heavily for years in automatic manufacturing equipment. These expenditures exceeding $100,000.00 per year have, for the most part, been designed for the assembly of electronic components, i.e.: Tube sockets, connectors. These products have, on the average, a short life due to technical obsolescence and are in most instances produced to specific customer design specifications. In view of these characteristics, the Bureau of Internal Revenue has allowed the full charge-off of all costs, including both design and construction, as an expense in the year of acquisition or on an as-completed basis.

"This may well sound as if we have achieved a major concession. In some respects we may have received consideration, but all of these funds have been spent on products of a high degree of obsolescence and this appears to be a key point."

Another vice president of an automotive parts firm concurs: "This is sound thinking, and has been done for years by allocating such costs separately, rather than tying in with basic equipment costs."

Observing that individual practices will vary depending on the particular company fiscal and accounting policies, W. M. Moffatt, executive vice president, American Brass Co., has this to say: "In general it is our practice to charge all basic research, whether for a machine type or product line, to current expenses. Direct engineering costs for a successful machine are capitalized with the unit or units initially constructed. Engineering costs applicable to modifications due to faulty original design would be charged to current expense."

Depending upon interpretation of the Code, there may be an area for some concern since the restrictions indicate if any research is expensed, all must be unless otherwise authorized by IRS. Here the over-all company operations must be studied to evolve a suitable policy. This method of handling is evidenced in the comment of E. L. Goff, senior vice president, Associated Spring Corp.: "In this connection, special engineering is handled through Associated Spring research and development services, a large portion of the expense involved would come under the normal research budget. In special cases of prototype development on production equipment, the costs are charged back through expense and general burden distribution."

W. J. Delahanty, vice president, Burroughs Corp., comments pointedly: "The obvious tax advantages, if these costs were to be written off as expense, have not been overlooked." However, there is evidence

that the advantages often are overlooked by other individuals. Witness such statements as: "Whenever we purchase substantial machinery items, it is true that the vendors engineering is included, usually directly in the cost upon which their quotation is based. I doubt if the Treasury Department would permit the expensing of vendors engineering even if billed separately if it were in connection with an over-all project."

There is need for careful segregation of expensable costs as indicated by M. J. Soberg, controller, Imperial Brass Mfg. Co.: ". . . costs of this nature are definitely expensable items. However, extreme care must be exercised in the handling of these charges. If an outside company were commissioned to build a special-purpose machine and no separation was made of engineering and research costs applicable to the special application, no grounds can be found for expensing a portion of the billed charges. If the charges are separated, they fall into the category of outside purchased services, these services being comparable to those rendered by our own machine design department."

In addition there is obvious value to having such detailed records, even though some executives feel that the work involved is an added expense. The value is basically underscored by this general superintendent's remark: "It is my opinion that a standardized approach should be used which segregates the engineering and building costs and thus lends itself to complete analysis for the determination of quantity acquisition and replacements of out-dated equipment or systems."

In the final analysis there appears to be a growing need for adequate recognition of research and experimental expenditures as a vital part of business operations. Today manufacturing engineering work of this nature must be accorded the same status as product development and research. There is real value to be gained not only in terms of solid accomplishment but also in terms of capital reserves, after-tax returns, and depreciation.

### Opportunities in Updating

Do you have a clear-cut policy on capital equipment? Are all phases studied and fully evaluated so all parties concerned understand the how and why? If not, it is a pretty sure thing that some real opportunities are being missed in terms of dollar profits and keeping productive equipment competitive.

Tax law places some restrictions on capital equipment policy but it also offers some real incentives for a careful investigation of the advantages it offers.

Equipment builders find that many engineers handling equipment development have too little understanding of effective capital equipment policy. There appears to be more importance in making equipment costs fit a preconceived budget than in achieving the optimum in effective equipment and profits. What is in fact a partial research project with considerable risk character is looked upon as a "cut-and-dried" operation of proved operational ability.

A new look at equipment policy will reveal definite need for broader understanding and improved management communications to all involved. Have IRS Code regulations been evaluated? Is engineering research on special machinery development handled separately and expensed? Are expendable tooling portions of equipment handled separately and expensed? Does the equipment have a definitely ascertainable life? To insure a sound policy, these along with the many other questions raised here need consideration.

Updating capital equipment policy to suit the times has become a must. Check yours to insure sound future development and adequate return on investment.

## ▶ A Look at Depreciation

Acquisition of capital facilities invariably involves the problem of depreciation. There is no question that depreciation reform is highly desirable and necessary for meeting today's changed conditions. Use of unrealistic useful life spans for equipment creates considerable burden where relatively standard manufacturing equipment is involved. The story on automated equipment and plants, however, is considerably different and as discussed in this article involves a considerably different approach. Here research and experimental costs play an important role and need not be considered as an integral part of the cost to be capitalized.

The problem is highlighted in this remark by M. F. Hughes, controller, Faultless Caster Corp.: "The next facet of the problem is the tax consideration involved. There has been a rather steady erosion of the purchasing power of the dollar during recent years. As a result depreciation reserves are no longer adequate to replace the capital equipment of industry. Under these circumstances, the financing of replacement equipment becomes increasingly difficult, and the improvement of capital facilities almost impossible.

"This situation is very graphically illustrated by the tremendous growth of leasing operations, wherein the prime factor in the decision to buy or lease is the immediately available income tax deduction of the rental payments under a lease agreement. It seems to me that tax considerations indicate there is much to recommend the charging of all engineering costs to current expense."

In commenting on the rate of return analyses for new equipment investments, Joel Dean[5] has stated: ". . . the ranking of proposals will differ significantly from the before-tax ladder if taxes are correctly taken into account in computing rate of return. For example, accelerated amortization can convert a border-line project into a highly profitable investment opportunity." In the same vein, Gordon Shillinglaw[6] observes: "Expensable portions of the investment outlay and accelerated amortiza-

tion influence the desirability of making some investments because, although they decrease the after-tax earnings in the initial year in the case of expensable items and in the early years with accelerated amortization, they do so by accelerating the government's contribution (in the form of lower taxes). The net effect of these tax influences is, however, to reduce the amount of capital tied up in the facilities."

Unless there are some rather unusual conditions to consider, it is obviously most advantageous profitwise to write off costs as rapidly as possible. Authorities indicate this is especially true where income tax rates are high and there is no expectation for a significant increase in rate in the foreseeable future. Thus there is little advantage to burying manufacturing research costs in capital equipment.

Neither is there significant advantage in confining attention to selection between different methods of depreciation on machinery. Advantages in returns among the different methods are not nearly so large as the advantages found when applying fast write-offs.

Actually, other factors being equal, the more rapid the writeoff for tax reasons, the faster the payback period. It has been shown by authorities that the more rapid the writeoff the greater the rate of return after income taxes. In addition are other advantages of importance[7]:

"1. Generally speaking, if matters turn out badly, they will not turn out so badly with a rapid writeoff as they will with a slow writeoff.

"2. In the common case where enterprise funds are limited, more cash is made available for productive use at an early date by a rapid writeoff than by a slow one."

Although there are many influencing factors that must be considered, the important point here that is also emphasized is proper recognition of current expenses that should be reflected in selling prices. Where current manufacturing engineering research and experimental expense is lumped in capitalized equipment, there is less chance for recovering all this investment through depreciation. Recovery is limited to that part used up through decrease in value of the machinery or plant system. Since this research effort must be of a continuing nature to remain competitive, depreciation return of capital for carrying on such work would be inadequate.

By using modern discounted cash flow techniques, bringing in the time effect on investment, it has been adequately proved that near-year returns far outweigh far-year returns. It is estimated that at a 10 per cent discount factor a dollar of after-tax saving twenty years hence is only worth about 15 cents today. Realistic study of investment with this technique emphasizes immediate or short-term returns rather than long.

### Regulation §1.174

"The deductions . . . for expenditures in connection with the acquisition or production of depreciable property to be used in the taxpayer's trade or business are limited to amounts expended for research or experimentation. For the purpose of the preceding sentence, amounts expended for research or experimentation do not include the costs of the component materials of the depreciable property, the costs of labor or other elements involved in its construction and installation, or costs attributable to the acquisition or improvement of the property. For example, a taxpayer undertakes to develop a new machine for use in his business. He expends $30,000 on the project of which $10,000 represents the actual costs of material, labor, etc., to construct the machine, and $20,000 represents research costs which are not attributable to the machine itself. Under section 174(a) the taxpayer would be permitted to deduct the $20,000 as expenses not chargeable to capital account, but the $10,000 must be charged to the asset account (the machine)."

## ▶ Recognize the Opportunities

As operations move more and more into automated systems, it appears desirable for management to carefully evaluate the methods for handling capital equipment additions. It is rather obvious that considerable variation exists in present procedures. There is much to be gained through a uniform approach. Not only can more accurate and detailed knowledge of real costs be assured but some larger business advantages are the prospect.

If it is wholly acceptable to expense costs as in-plant equipment development is carried out, is it any less desirable or unreasonable to similarly treat the same costs incurred in dealing with equipment builders? The problems are the same, the results little different, and the risks no less. In addition, the builder will be able to do a better job and, in many cases, remain actively in business.

With manufacturing research given its proper recognition and status there will be a far greater number of talented engineers attracted to this field of endeavor. Unlimited opportunities for increased production efficiency await those who organize and plan to meet the needs of the "Automating 60's." Manufacturing research and engineering will play a key role.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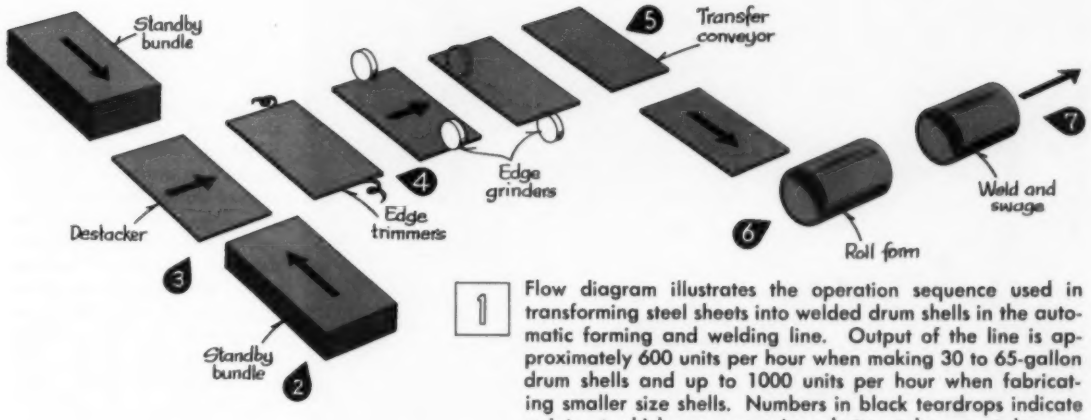



1 Flow diagram illustrates the operation sequence used in transforming steel sheets into welded drum shells in the automatic forming and welding line. Output of the line is approximately 600 units per hour when making 30 to 65-gallon drum shells and up to 1000 units per hour when fabricating smaller size shells. Numbers in black teardrops indicate points at which accompanying photographs were taken.

AUTOMATION TODAY

# FABRICATING STEEL DRUM SHELLS

WHEN integrated lines are producing various styles of parts at a rate of 600 to 1000 units per hour, downtime for product changeover and machine setup can play havoc with production efficiency if prolonged for any length of time. Therefore, when such facilities are being designed, engineering effort that results in providing quick changeover features to reduce downtime to a minimum is well expended. A case in point is a new forming and welding line which was recently installed in the Chicago plant of Inland Steel Container Co.

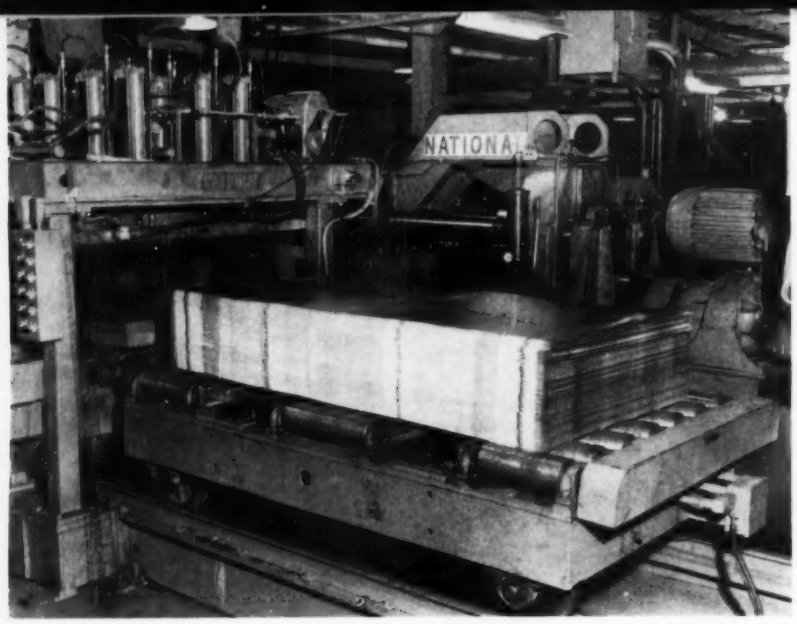
The line is designed to automatically form and weld steel drum shells from hot or cold-rolled sheet, 28-gage to 14-gage in thickness, and consists of sheet handling, edge trimming, edge cleaning, forming, welding, and swaging equipment. Designed and built by National Electric Welding Machines Co. in co-operation with Inland Steel engineers, the line is equipped with quick changeover provisions so that it can accommodate any of three drum diameters. Motorized adjustment features fitted to the line's automatic sheet handling, trimming, edge cleaning, forming, and welding stations cut setup time to a fraction of what it formerly required to convert from one container size to another.

Production capacity of the automatic equipment is up to 600 steel shells per hour when making conventional drums of 30 to 65-gallon capacity and up to 1000 units per hour when producing smaller sizes such as 100-pound grease drums. The machine normally handles mill cut steel sheets ranging in size from 44 to 72 inches in length and 15 to 42 inches in width. Sheets up to 79 inches in length can be accommodated with additional tooling.

The accompanying illustrations show the various operations performed in converting the steel sheets into drum shells. Flat plain or lithographed sheets are fed into the line by means of vacuum pick-ups and magnetic rolls. The sheets are then conveyed through an edge trimmer which maintains sheet size to within 0.005 inch. Trimming two edges of each sheet allows the company to use mill cut sheets and eliminates extra material charges for precision cut stock at the steel mill.

An automatic two-stage device uses a new method to remove scale and rust from the top and underside edges of the sheet where welding will take place. National Electric Welding and Inland Steel engineers developed the application of a new type abrasive wheel which is used for the first time on this line. Reports indicate that the new method is more efficient, less costly, and achieves a cleaner over-all operation than fixed grinding wheel or shot blasting methods.

After edge cleaning, the sheets are transferred laterally to the drum forming, welding, and swaging line. A three-roll forming station rolls the sheets into drum shape. Held in this shape by guide rolls, the drum shell is conveyed between three hourglass rolls which size and hold the drum to close tolerance diameters during the actual welding operation. After welding, the weld seam is mashed to obtain a smooth interior finish for uniform lining application. The finished shells are then upended onto a live roller conveyor and transported to other drum fabricating equipment.



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At the beginning of the line, stacks of plain or lithographed steel sheets are loaded on either of two motorized dollies by fork trucks. The dollies are mounted on tracks which extend to each side of a vacuum feeding unit. This permits one dolly to be loaded while sheets are being fed to the machine from the other dolly. The line will handle sheets ranging from 44 to 72 inches in length and 15 to 42 inches in width. With additional tooling, 79-inch long sheets can be accommodated.

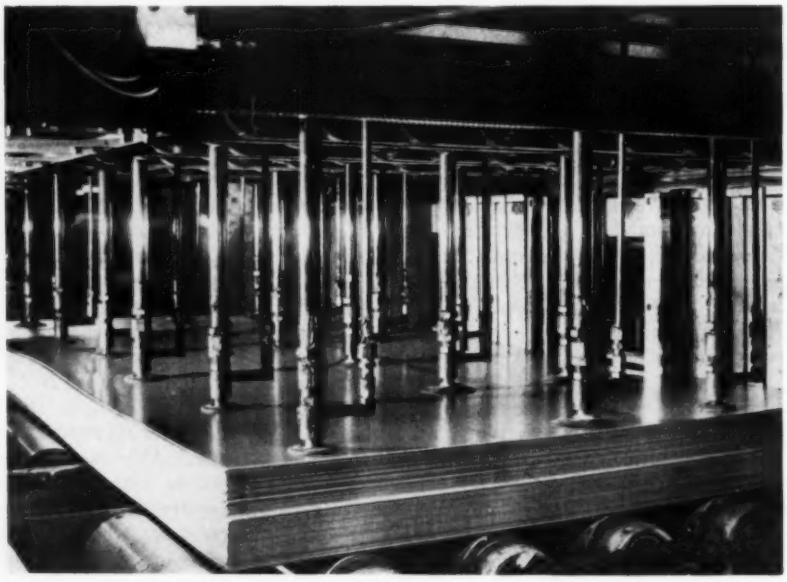
Many features are included in the line to provide fast setup time when changing to drums of different diameters. For example, the hour-glass sizing rolls at the welding station are mounted on a rugged A-frame which is secured to the welder chassis by means of quick-release air lock pins. A change in drum diameter is accomplished in minutes by releasing the lock pins, lifting out the entire A-frame assembly, and replacing it with a larger or smaller hour-glass roll frame unit. All electrical and air lines leading to the assembly are fitted with quick-change connectors.

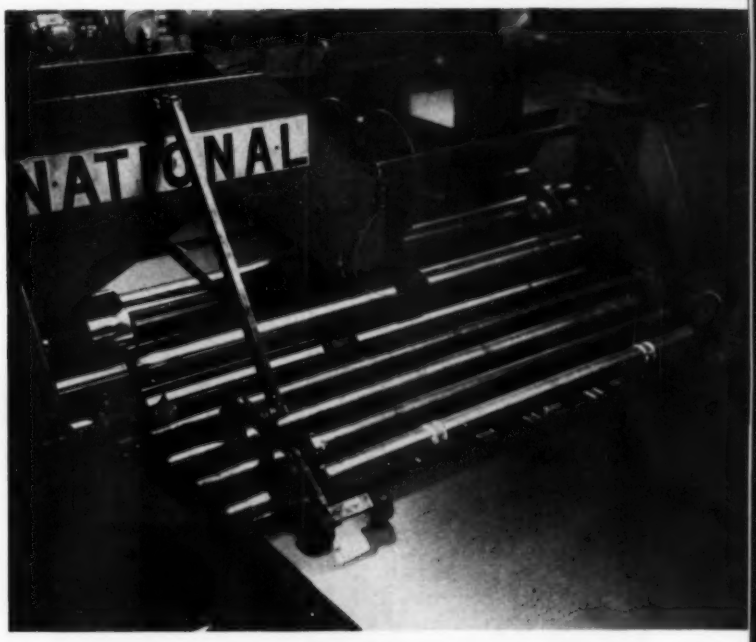
The weld rolls are automatically greased by a motor actuated centralized lubrication system manufactured by the Trabon Engineering Corp. All other greasing points are piped to a Farval hand pump for easy greasing by maintenance personnel. Particular attention was given to greasing points to prevent any dripping of grease on the drum shells.

Pushbutton control allows the roll forming station and the side guide roller assemblies to be instantaneously adjusted when drum sizes are changed. The lower roll of the swaging unit is of split type design with a threaded type adjustment for easy widening or narrowing of the groove to accommodate various gages of metal. At the edge cleaning operation, an

3

In the feeding unit each steel sheet is secured by vacuum pickups and lifted to magnetic rolls from which it is then fed to the right into the edge trimmer. The vacuum pickup and release of the sheet is timed so that the sheet will properly enter the trimmer and feed between two lugs on the sheet preparation conveyor. This method of handling was necessary to prevent marking or scuffing the lithographed surface of the steel sheets.



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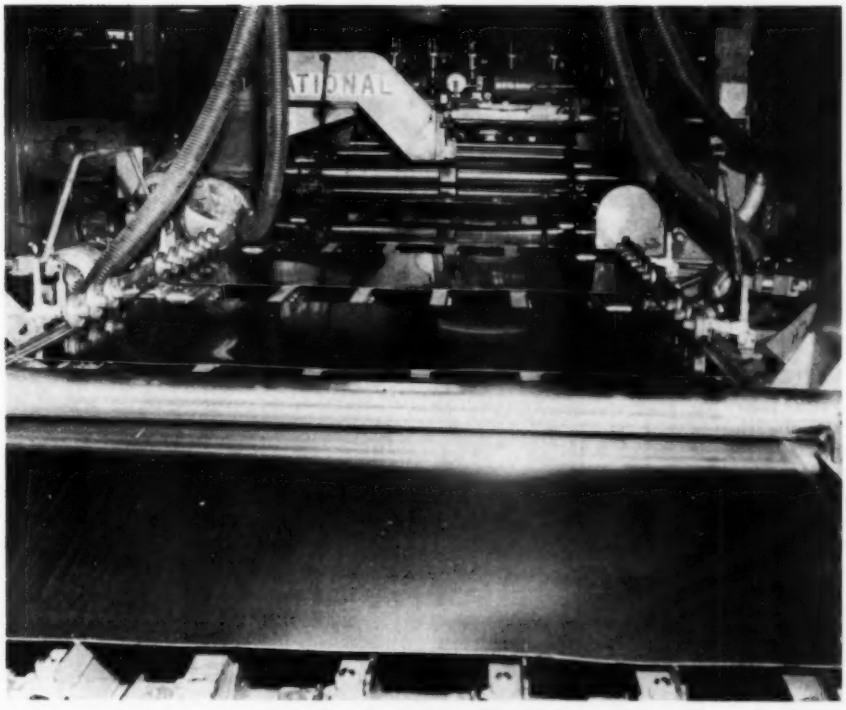
Lugs on the sheet preparation conveyor pick up the sheet and move it through this squaring and edge-trimming unit. The two edges of the sheet are trimmed so that sheet length between the cutting tools is held to within 0.005 inch. The conveyor then moves the sheet through the edge cleaning equipment.



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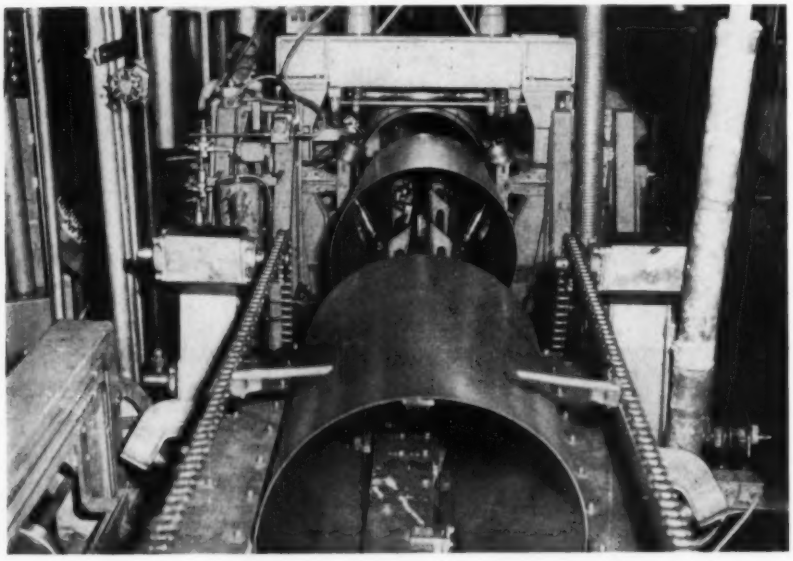
This view shows the entire sheet preparation line. In the center background can be seen the vertical cylinders which actuate the vacuum pickup devices. Immediately in front of this unit is the squaring and edge-trimming equipment, located under the arched structural support. The sheet is then conveyed under the upper edge cleaning abrasive wheels which are the circular units connected to flexible hoses on each side of the sheet. These units clean the side seam of rust and scale along the edges where the drum shell will be welded. A similar cleaning operation takes place on the underside of the sheet edges at the next station which is located under the series of hold-down rollers on each edge of the sheet. In the foreground is a transfer station which pushes the sheet to the left into the drum forming rolls.

automatic adjustment system compensates for any abrasive wheel wear that might result from continuous operation.

Controls for the new line include phase-shift heat controls, two tube contactors, current regulator, and an auxiliary heat potentiometer. A 400-kva single phase transformer provides weld current. An upslope device controls the magnitude of the current on the leading edge of each drum shell. Provisions are included for indicating and identifying defective operation of an ignitron tube. The master control panel also includes a special monitoring device consisting of an oscilloscope and a selector switch which pinpoints trouble spots in any of 10 electrical circuits in the weld current contactor. The control system for the line was provided by the Specialty Control Dept., General Electric Co.



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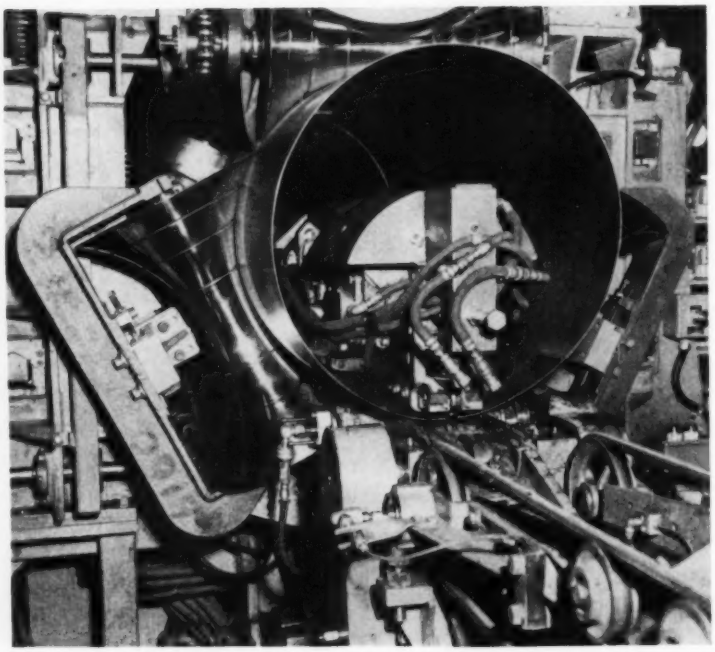
As the sheet is transferred from the preparation line (out of the picture to the left and parallel to the line shown), it passes through a three-roll forming station and is rolled into drum shape. Adjustable side guide rollers contain the shell until it reaches the welding station under the heavy framework in the center background. The roll forming station is motorized, and the shape of the shell can be tightened or loosened by a pushbutton jogging control. The side guide roller assemblies are also motorized so that they can be easily adjusted for larger or smaller diameter shells.

7

Drum diameters are held to close tolerance during welding by a sizing mechanism consisting of three hourglass rolls mounted on the two sides and at the top of a rugged A-frame. The upper weld roll, behind the swaging unit inside drum shell, and the lower weld roll are both driven and water cooled. Work is carried through the weld station at a speed of 40 feet per minute. While the metal is still ductile, the welded seam is swaged to obtain a smooth interior surface for a lacquer lining which is applied in a subsequent operation. Metal displaced by swaging is contoured on the outside of the drum shell. As the shell leaves the swaging unit, it is picked up by the twin belt conveyor in the right foreground and carried to a handling device which upends the shell onto a live roll conveyor for transfer to the balance of the drum fabricating line.



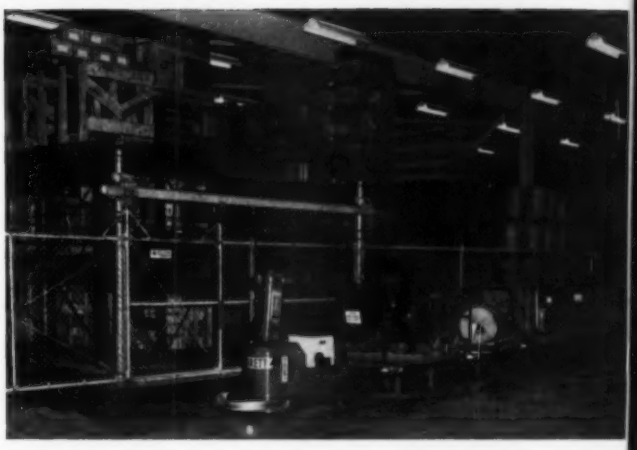


Fig. 1—Driverless tractor can tow up to five trailers along preset route defined by copper wire embedded in factory floor. In position shown, tractor and trailers have been stopped automatically after passing through gate at right.

# PROGRAMMED TRACTOR PLIES MULTIPLE ROUTES

A BATTERY-OPERATED tractor-trailer system used in the Baton Rouge refinery of Esso Standard, Div., Humble Oil & Refining Co., can be programmed to travel automatically over three closed routes and stop at 16 preselected stations for loading and unloading. The device, which requires no driver operator, can also automatically open and close gates in its path of travel.

One of the functions of the unit, manufactured by Barrett-Cravens Co., is to deliver materials from a warehouse storage area to other sections of the building. It is also used to transport repair parts to a maintenance section where petroleum equipment is serviced and repaired. Up to five trailers, each having a 4000-pound load capacity, can be towed by the tractor.

The tractor follows the path of a copper wire embedded in a shallow groove in the concrete floor of the building. The wire is energized by a low-voltage current, and transmits guide signals to an electronic sensing device mounted on the tractor.

As the sensing device on the tractor follows the guide wire in the floor, the tractor trailer may be led on straight or curved paths through open or congested factory areas. Speed is adjustable, but is normally set at 2.75 mph. If the tractor is pushed off the guide path by an outside force, or collides with an obstruction, it is stopped rapidly by dynamic braking action.

In one storage area, *Fig.* 1, the tractor trailer must pass through two gates that are spaced within 45 feet of each other. The first gate is a swing-in type, and the second is a sliding type. Each gate requires about 6 seconds to open fully.

Wire configurations, called beacons, are embedded in the floor on either side of each gate alongside the guide wire. The beacon circuits comprise a separate control system from that used to guide the tractor. As the tractor approaches the first gate, a signal from a transistorized transmitter on the tractor is picked up by the beacon ahead of the gate. This signal is amplified by a remote receiver and used to energize a relay. Operation of the relay actuates a motor that drives a lever arm through a gear reducer. This action swings the gate open. Should the gate fail to open fully for any reason, the tractor will be stopped.

As the tow train clears the open gate, the tractor passes over a second beacon. The signal from the transmitter on the tractor is picked up by this beacon, and control actions are initiated to close the first gate.

After the tow train has traveled a short distance beyond the first gate, the tractor moves over another beacon and is stopped automatically. The position of the tow train then corresponds to one of

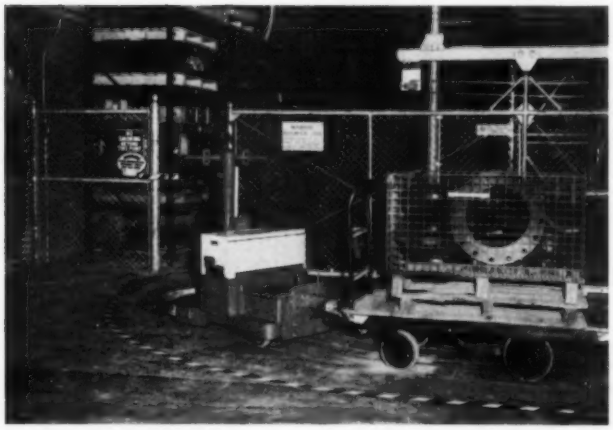


Fig. 2—After servicing at a load or unload station, the tow train is started on its way by operation of a push-button on the tractor. Unit is shown entering enclosed storage area. Sliding gate is opened and closed automatically by signals from a transmitter on the tractor.

16 preselected stations that can be programmed by means of switches on a control panel mounted on the tractor steering column.

When the tow train stops, a horn on the tractor sounds intermittently to signify that the trailers require servicing. After servicing, the tractor trailer is sent on its way by operation of a pushbutton on the tractor. The unit then passes through the sliding gate, *Fig.* 2, which is opened and closed by beacon signals, and on to other stations in storage and maintenance areas.

The unit can be halted at any point along its route by operation of a stop button on the tractor. It can also be operated manually on any path by a driver at the tractor controls. In manual operation, speed can be advanced to 3.5 mph.

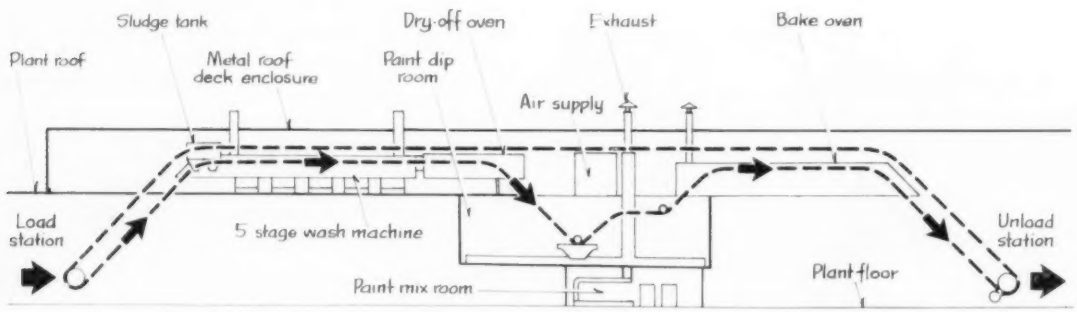
# INTEGRATED LINE PAINTS ENCLOSURES

RATHER THAN being a point of disruption in production flow, the painting line in a new Cutler-Hammer Inc. plant is a natural part of the production cycle—so well integrated with other operations that it provides a smooth link between fabrication and assembly work. Painting capacity and efficiency were upped by eliminating special devices often needed to circumvent obstacles in existing plants, and fabrication and assembly operations were designed to synchronize with the speed and capabilities of the finishing line. Savings in floor space were made by locating equipment on the roof and by a systematic method of tying in both fabrication and assembly.

The Industrial Equipment Division, R. C. Mahon Co., produced and installed the conveyorized automatic line. Their people point to the installation as a good example of how, through advance planning, better return on investment can be obtained in new plant and expansion programs. Said one, "This is one of those rare cases in which we were called in on the job before the plant and its internal layout hit the drawing-board stage. By taking part in the early plant-planning with Cutler-Hammer engineers, we were able to integrate to such an extent that everything in the plant looks like it belongs—rather than an afterthought."

In the new plant, metal enclosures are made in various sizes for low-voltage distribution systems. As the work comes from the fabrication area, a worker hangs the parts on a conveyor by means of wire hooks. The work then travels through the cleaning machine, is dip-painted with synthetic enamel, and is baked at 350 F for about 30 minutes in a gas-fired oven. After baking, the work is returned to the main floor, where a worker unloads it at the beginning of the assembly operations.

The paint dipping room has its own filtered air supply system, and, since the painting area is also closed off to plant traffic, rejects due to dirt are minimized. A paint mixing and recirculating system is included in the setup, and a system for transposing dipping tanks makes quick changes of material on the line possible. Another feature of the line is use of high pressure hot water at 300 F to heat both the supply air and the cleaning machine. Since most of the line's equipment is on the roof, radiation of process heat is not a problem.




**Elevation view shows painting line that was designed and built as an integral part of a new plant producing metal enclosures. Engineers connected with the project were given the opportunity to consider painting requirements at an early stage of planning. The result is a smooth flow of work from fabrication, through painting, and to assembly.**

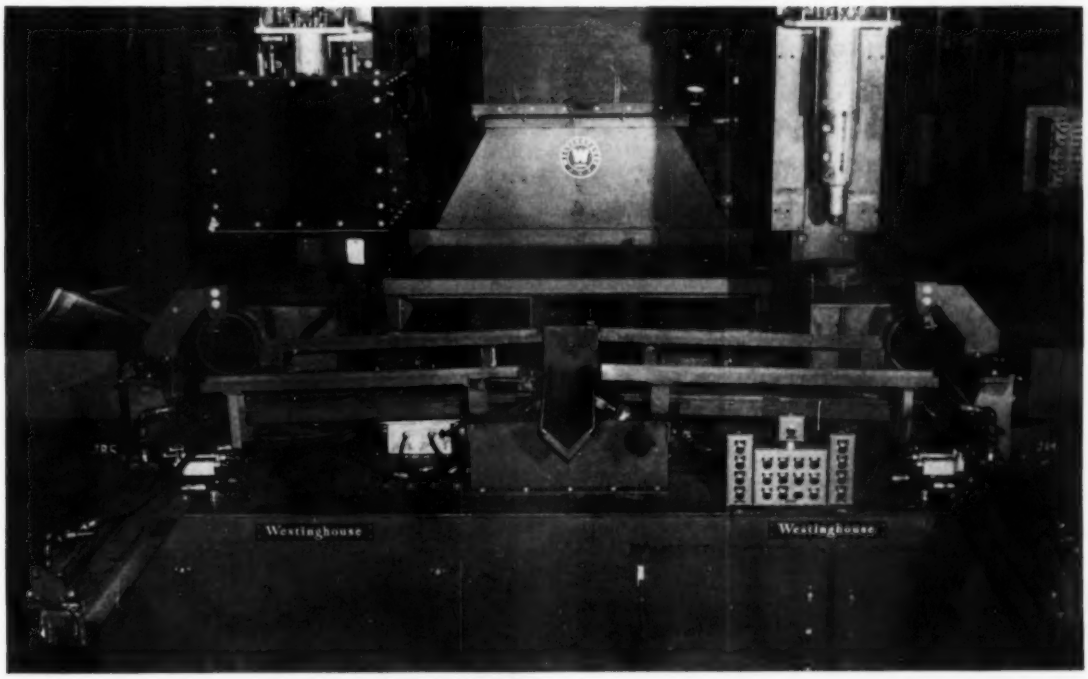



Fig. 1—Photograph taken during construction of one of two special induction heating machines for 8-inch H. E. shells shows inlet end of the dual-line equipment. As shown, induction heating coil box is in position for lefthand line. Self-aligning mandrel is exposed for righthand line. Machine was developed by Westinghouse Electric Corp.

# AUTOMATIC INDUCTION HEATING LINE

## EMPHASIZES PART HANDLING

**Effective automatic equipment results from a successful combination of processing, control, and handling techniques. This case study illustrates how a novel handling mechanism can satisfy complex requirements and yet simplify the design of production equipment.**

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THE RELATIONSHIP between handling, control, and effective processing is highlighted in special equipment developed for induction heating. As a production technique, induction heating is ideal where requirements call for rapid heating and accurate control of both temperature and area to be heated. Properly designed handling equipment permits discrete items to the processed in production quantities. These aspects of processing and handling

*Subsequent to the preparation of this article, Mr. Brown joined the Western Electric Co. Inc., Baltimore, in the capacity of Design Engineer.

are exemplified in induction heating equipment, *Fig.* 1, developed by Westinghouse Electric Corp. for annealing 8-inch H. E. artillery shell forgings.

There are two stages in the shell forging line where annealing is required. In the first or process anneal stage, a forged steel extrusion (approximately 21 inches long, 8 inches in diameter, and weighing 165 pounds) is heated to 1250F, 13 inches back from the open end. In the second or nose anneal stage the shell forging (31 inches long, 8 inches in diameter, and weighing 165 pounds) is heated to 1550F, 8 inches back from the open or nose end. In addition to heating, controlled air cooling down to a temperature of 600F is required. The shell is then water quenched down to or near ambient temperature.

## Handling Considerations

The shell is most conveniently delivered to equipment on a roller conveyor, with the shell horizontal and nose end leading. The most desirable position for the shell during heating is standing vertically as this position simplifies moving and clamping; mill scale and other foreign matter tend to drop out of the heating coil, promoting cleanliness. The most desirable position for cooling is with the shell lying horizontally and lengthwise to the travel of a conveyor. In this position provision for rotation of the shell to obtain uniform cooling is relatively simple, and the cooling tunnel length will be held to a minimum. Thus, these conditions pose the problem of orienting the shell in three positions: One for loading, one for heating, and one for cooling—each position being 90 degrees from the other two.

In order to minimize the quantity of mechanisms required, a means was developed to position three shells in one holding fixture and to index all three positions simultaneously, *Fig.* 2. The unique indexing device consists of a cubic fixture fabricated from steel plate. It is mounted on the end of a spindle, the axis of which runs through diagonally opposite corners of the cubic fixture. Three cylindrical sleeves, each running through a pair of opposite sides of the cubic fixture, form the holding medium for the shells. This arrangement provides for the required three positions, each 90 degrees apart.

In indexing, the fixture is rotated 120 degrees on its inclined spindle, thus advancing each shell one position, or 90 degrees, from its last position. While in the fixture the shell is held in place in all positions by gravity. A spring steel bumper prevents the shell from dropping through the cylindrical sleeves when the sleeves are in a vertical position.

A pneumatic, pivot-mounted rotary-type cylinder is used to index the fixture by means of spur gearing. After an indexing stroke, the rotary cylinder with its gear is disengaged from the spindle gear by an air-operated rotary cam. The rotary cylinder is then reset and re-engaged with the spindle. Before disengagement, the rotary cam locks the spindle in a fixed position by moving a locking arm into a notched disc on the spindle. The spindle must be locked in one of the three indexing positions before disengagement or re-engagement can take place, and the spindle gear must be fully engaged with the rotary cylinder gear before the lock can operate. Thus, the fixture is under positive control and mechanically interlocked at all times.

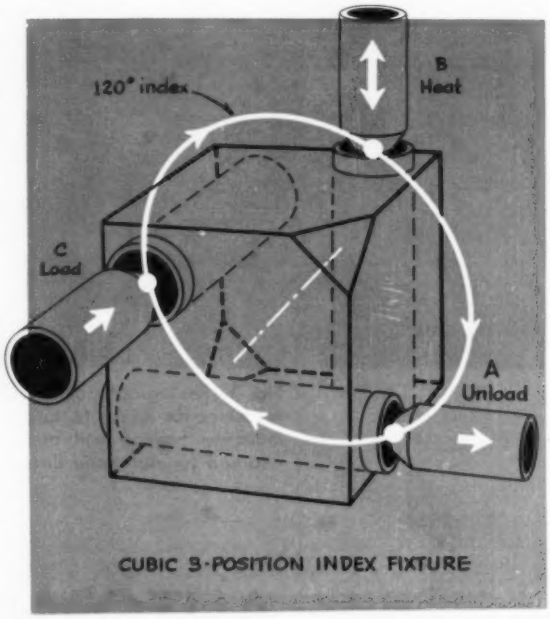



**Fig. 2—Unique cubic indexing fixture contains three holding tubes to handle three shells simultaneously. As fixture is indexed through 120 degrees about its axis which runs diagonally through the indicated opposite corners of the cube, the surfaces of the cube are indexed 90 degrees. Clockwise indexing of this lefthand fixture move parts from loading positions, through heating position, to unload position.**

## Machine Operations

Due to production requirements and heating time a dual-line machine was provided for each of the two annealing stages, each line being equipped with a cubic indexing fixture. Either line of each stage can be run singly, or they may be run together, a common timer synchronizing the operations. Manually operated pushbuttons are provided for moving the first shell through the machine. After the first shell is heated, the operation of the equipment is automatic, being controlled by limit switches triggered by a shell as it passes through the machine.

In operation, *Fig.* 3, a shell is deposited on a selector trough from a conveyor. The shell enters

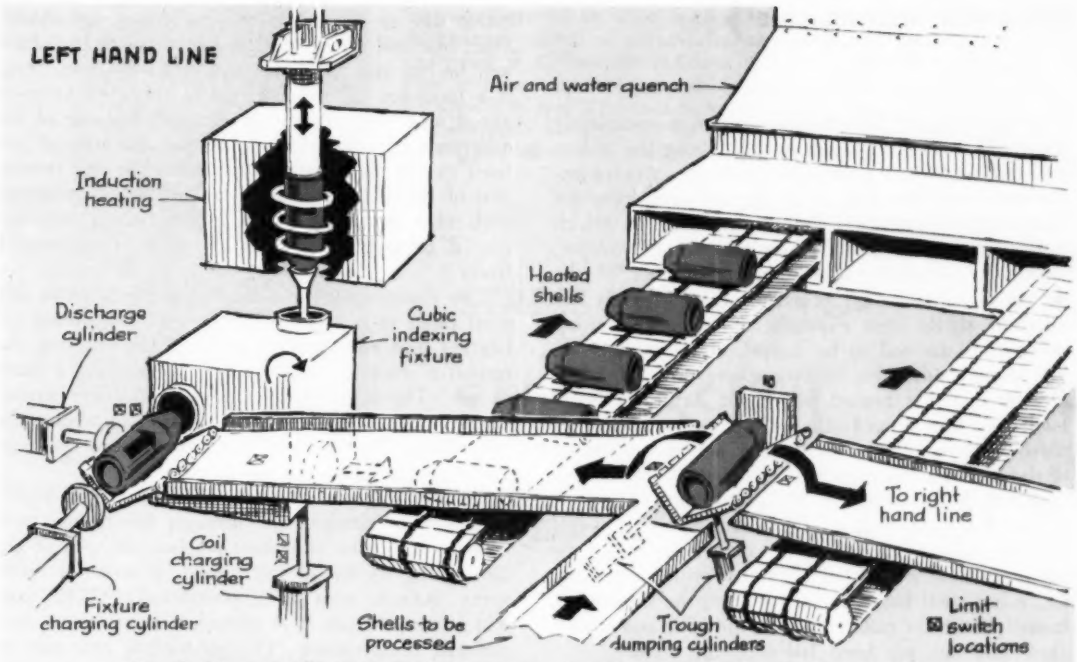
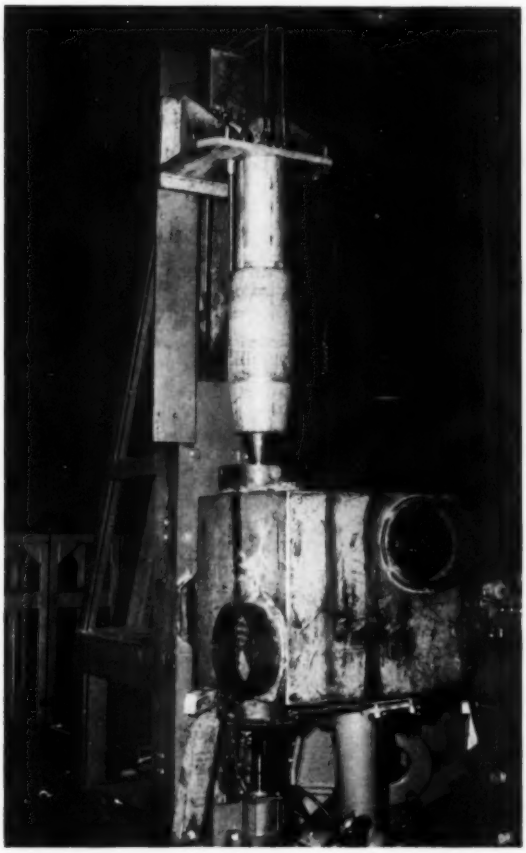



**Fig. 3—Diagram illustrates major features of automatic induction heating machine. After initial shell has been cycled through operations by pushbutton control, operation of machine is automatic, sequenced by limit-switches actuated by moving workpieces.**



the trough, closed end leading. The selector is a roller equipped trough, hinged on both sides, and operated by an air cylinder on either side. On a given electrical signal, one of the cylinders tilts the trough, causing the shell to roll down the desired ramp into position on a fixture loading trough. From here the shell is pushed into the cubic indexing fixture by an air cylinder. When the fixture is indexed, the shell ends up in a vertical position over a coil charging cylinder, which is actuated as soon as the indexing mechanism is unlocked. The shell is pushed up by the charging cylinder into the induction coils and over a self-aligning mandrel where it is locked into place by the force of the piston which expands the mandrel jaws against the shell, *Fig.* 4.

A heat cycle timer is automatically started by a circuit established as the shell is positioned and locked into place. At the end of the timed cycle, the timer interrupts the heating operation and the coil charging cylinder lowers the heated shell back down into the cubic indexing fixture.

**Fig. 4—Details of a righthand cubic indexing fixture and its relationship to mandrel is illustrated. In this picture taken during buildup of the machine, the coil charging cylinder has been actuated, its piston rod passing through the cubic fixture to raise a forging into heating position.**

## INDUCTION HEATING LINE

As soon as the coil charging piston is completely retracted, the fixture indexes. Following the indexing of the fixture, a horizontal discharge cylinder immediately actuates and ejects the hot shell from the fixture onto a gravity trip dump mechanism, which in turn releases the hot shell onto a cooling conveyor.

During automatic operations, a number of the indicated actions are occurring simultaneously for different shells. For example, as a shell is being raised into the coil to be heated, a hot shell is being ejected onto the cooling conveyor; and while a shell is being heated, the cubic fixture is being loaded. Thus, three different operations involving three different shells take place between indexing of the fixture: For example, heated shell *A* is ejected from the fixture; shell *B* is heated; and shell *C* is loaded into the fixture. The fixture-indexing cylinder is reset during that part of a cycle when the three positions in the cubic fixture contain no shells, i.e., a hot shell has just been ejected, the shell being heated has been raised up into the coil, and a new shell has not yet been fed into the fixture.

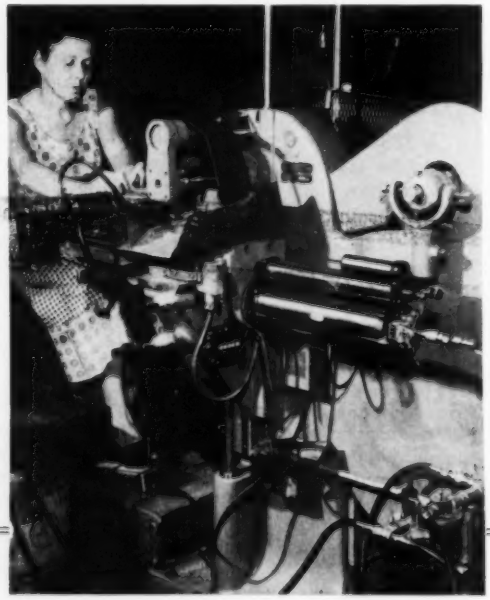
The cooling phase of the operation involves a dual conveyorized, insulated tunnel. The shells are carried through either side of the tunnel on endless roller chains. Located between two sets of rollers on the chain, the shell is caused to rotate as the rollers rotate due to the advancing motion of the chains. Since one end of the shell in contact with the chain will be hot and the other end relatively cold, there is a tendency for the hot end of the shell to creep ahead and over its supporting roller because of the difference in circumference of the two ends of the shell caused by thermal expansion. For this reason, one of the chains in each set of two is equipped with idler or free-wheeling rollers which are kept out of contact with the chain track, thus turning freely.

The chain conveyor drive is geared to move one shell pitch in a little less time than is required for heating and reloading. Each shell on entering the conveyor starts the drive motor by tripping a ramp switch. The conveyor is stopped by a cam-operated switch when the chain is in position to receive the next shell. This method of control keeps the conveyor synchronized with the heater.

Cooling is promoted by a 15-hp fan of 30,000 cfm capacity drawing air through the tunnel from both ends. When the shell reaches the end of the air cooling section of the tunnel, it enters a water spray quench area at approximately 600F, from which temperature it is quenched down to or near ambient temperature. The air-cooling rate can be controlled by adjustable dampers located in each tunnel air exit. On emerging from the quench area, the shell rolls onto a ramp on which it is turned around and deposited on the customer's conveyor for subsequent processing.

## automatic cycling speeds lock keypost milling

ONE of the components produced by the Mosler Lock Co. is a safe deposit box keypost made of hard, free-cutting brass. After being turned and chamfered on an automatic screw machine, each keypost must have a key slot 0.066 inch wide by 0.390 inch deep milled along its full length. As with all lock work, accuracy is of prime importance, and this operation is to be held within 0.001 inch.



A previous production method relied on a hand fed milling machine to mill key slots in about 115 parts per hour. A careful look at operations, when demand was increasing far beyond the capacity of the hand fed machine, indicated the need for a production improvement. After investigating a number of possible solutions to the problem, the plant manager decided on a milling machine equipped with an air vise, air-hydraulic table feed, and twin milling cutters to cut key slots.

Built by U. S.-Burke Machine Tool Div., Cincinnati Mfg. Corp., the machine enables one operator to mill key slots in 750 to 800 pieces per hour and maintain consistent accuracy within 0.001 inch. The operator inserts two workpieces into the vise and steps on a foot pedal. The parts are then automatically clamped in position; the machine table automatically rapid traverses, feeds, and rapid returns to starting position; and the milled parts are automatically ejected into a hopper.

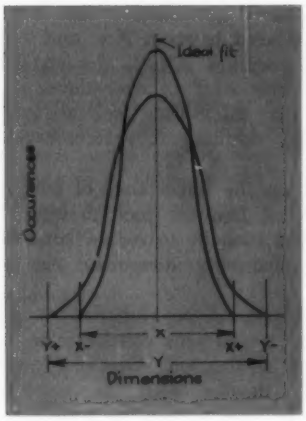



Fig. 1—Where fit, or other relationship, between parts is critical, the dimensional control of all parts concerned must be investigated. As illustrated, if *X* dimension indicates range of male part being assembled in female part of *Y* range, loose assemblies may be expected between $Y+$ and $X-$, and tight assemblies between $X+$ and $Y-$. This will occur even though, for example, the *X* dimension is well controlled and within a desired tolerance range.

## STRESS QUALITY FOR

# SUCCESSFUL AUTOMATIC ASSEMBLY

**An acceptable assembly results from proper assembly of good components. Quality of the end product, then, is a function of the quality of the assembly machine as well as the quality of the components. Obtaining the requisite level of quality in both of these areas is a challenge to the manufacturing function.**

By **ARTHUR J. LaRUE** Associate Engineer, Manufacturing Engineering, International Business Machines Corp., Burlington, Vt.

SUCCESSFUL automatic precision assembly necessitates quality considerations exceeding those required for manual assembly methods. These considerations apply both to the components which are to be assembled and the automatic machine since the quality level of end products depends on the reliability of the components and the reliability of machine stations in performing desired operations. If component and machine station reliability are both inadequate at the same time, the quality level of the assembly declines in geometric proportions.

In many applications modern means of controlling machine tools enable the production of components with sufficient accuracy and reliability as to depend comfortably on certain accepted sampling methods for quality control. However, an efficient automatic assembly machine requires 100 per cent acceptable parts, and not, for example, 99.50 per cent or less as some sampling methods permit. In short, sampling methods may not be sufficiently stringent. The magnitude of the problem varies with the complexity of the assembly, and, as the number of components being assembled increases the importance of having acceptable parts becomes more critical.

Equipment of low reliability can create problems out of proportion to the value of unacceptable parts involved. For instance, where low reliability exists, and the machine is controlled to police such conditions, it may be necessary for the machine to stop periodically, with resulting costly downtime. If the equipment is designed to sort defective assemblies, then there is the problem of salvaging or scrapping a proportion of production. Either alternative costs money, and the economic advantages of the assembly machine decline.

In machines which combine machining operations with assembly, further care is necessary in cases where fit is critical. For example, as shown in *Fig.* 1, if the tool capability curve is outside the component tolerance curve, loose assemblies may be

This article is based on a paper presented at 28th National Convention of the American Society of Tool and Manufacturing Engineers, Detroit, April, 1960.

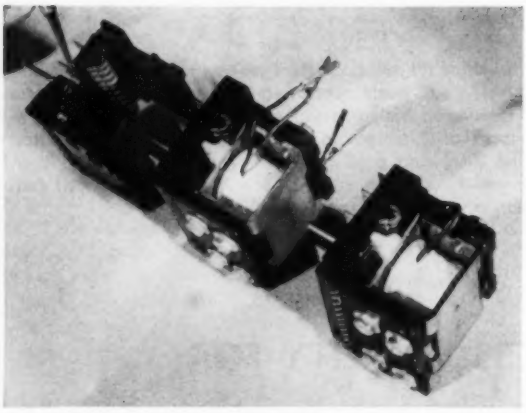


Fig. 2—Three stages in the assembly of a wire contact relay are illustrated. The partially assembled stage at left is accomplished by one automatic machine; a second machine is used to complete the assembly to the extent shown by the center unit. The completed relay at right includes components assembled manually.

expected between the lines $Y+$ and $X-$, and tight assemblies between the lines $X+$ and $Y-$.

The condition created is that of two components having dissimilar reliability curves. A typical example exists in a machine where a tapping operation is performed at one station and a screw is inserted at another. If a Class 2 fit is required, the Class 1 fit produced between $Y+$ and $X-$ and the Class 3 fit produced between $X+$ and $Y-$ results in defective assemblies. Or, if the conditions are compatible at the start of operations, care must still be taken that the cutting tools are not allowed to become dull, resulting in defects between $X+$ and $Y-$.

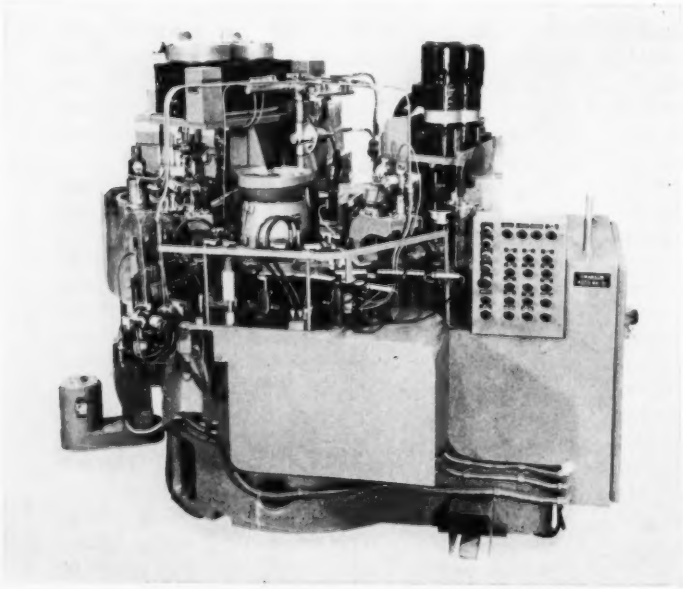
This points up the importance of adequate control of tools and frequent tool changes. Any attempt to expand tool life to reduce costs of changing and accompanying downtime has economic limitations.

Although this could be classified as an operational problem, it warrants consideration in design and equipment evaluation. Overload controls, or predetermining devices such as machine cycle counters, may be used to stop the machines or automatically change tools after a given number of cycles.

Besides incorporating into the machine as much control as possible, the human reliability element which existed in manual assembly must be reckoned with. Skilled and keen-sighted assemblers who can detect the slightest assembly flaw are difficult to replace, even with the most elaborate types of instrumentation. This requires a thorough analysis of quality requirements and usually results in an upgrading of acceptable quality levels.

Complete investigation of the components to be assembled is required, not only with respect to the

Fig. 3—Shown is one of two assembly machines used by International Business Machines Corp. for the partial assembly of a wire contact relay. The part as delivered by this 16-station machine is shown at the left in *Fig.* 2. Starred items in operational sequence are monitorial operations.



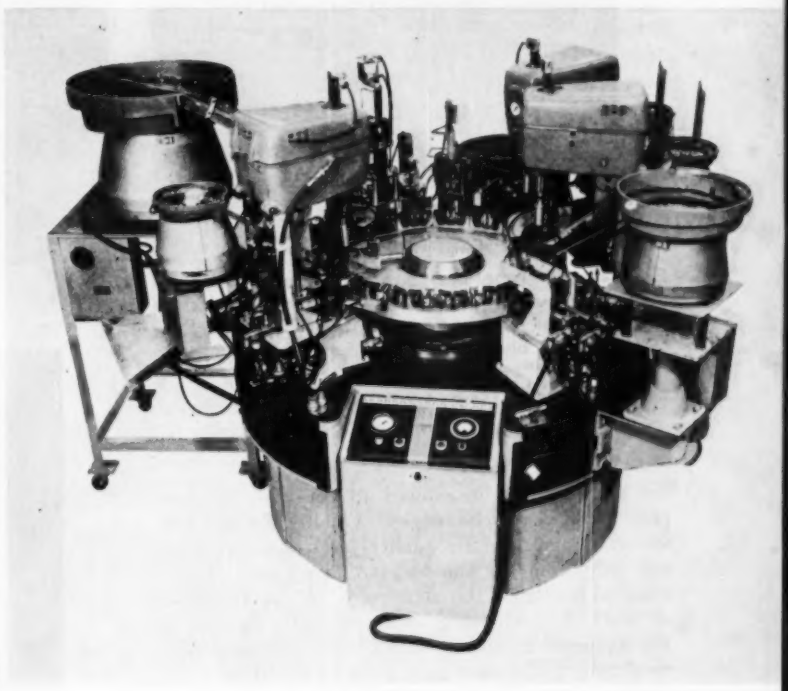
**Operational Sequence**

1. Load part.
2. Monitor for presence of part and its proper location.*
3. Countersink holes.
4. Tap one hole.
5. Tap other hole.
6. Air blast to clean for operations 3, 4 and 5.*
7. Monitor for broken tap. If broken tap is detected, all subsequent operations are automatically by-passed, and parts are discharged into rejection chute at Station 16.*
8. Insert one bumper.
9. Insert other bumper.
10. Monitor for presence of bumper. If bumper is not present, part by-passes all subsequent operations and is discharged into reject chute at Station 16.*
11. Insert adjusting screw into one hole.
12. Insert adjusting screw into other hole.
13. Insert guide studs.
14. Flare to fasten guide studs.
15. Monitor for presence of screws and studs.*
16. Discharge part in appropriate chute.

**Operational Sequence**

1. Orient, feed, and insert molding assembly.
2. Monitor for presence of molding assembly. If molding fails to load, the machine stops, enabling loading to be done manually.*
3. Orient, feed, and insert two springs.
4. Monitor for springs.*
5. Orient, feed, and insert armature.
6. Monitor for armature.*
7. Orient, feed, and insert contact wire holder.
8. Orient, feed and insert yoke, core, and coil assembly; and orient, feed, and insert two assembly screws on top side.
9. Monitor for assembly screws on top side.*
10. Orient, feed, and insert assembly screws on bottom side.
11. Monitor for assembly screws on bottom side.*
12. Orient, feed, and insert two other assembly screws on top side; set and monitor for proper location of contact wire holder.*
13. Monitor for assembly screws on top side, and discharge.* This is a 16-station machine, three of which are idle. The stations also rotate the assembly as required to expose the proper surface to the tooling.

**Fig. 4—Second assembly machine used to assemble wire contact relays, and its operational sequence, is illustrated. Center unit in *Fig.* 2 shows the extent of assembly completed by this machine. Monitorial operations are included to ensure corrective action if machine improperly functions.**



part print but also with respect to the actual part quality history, and any specifications or standards which may affect them.

The machine design must then be thoroughly studied and engineered. Specifications should be written to indicate exactly what is expected, and these should be rigidly adhered to in the course of construction. In many machines for assembling delicate electromechanical devices, the influence of vibrations and acceleration, for example, must be considered in addition to reliability, maintenance, and life expectancy.

As more experience is obtained with automatic machines, specifications and requirements are inclined to become more stringent and definitive. This contributes somewhat to an increase in the cost of the machine, but the added investment is always worthwhile.

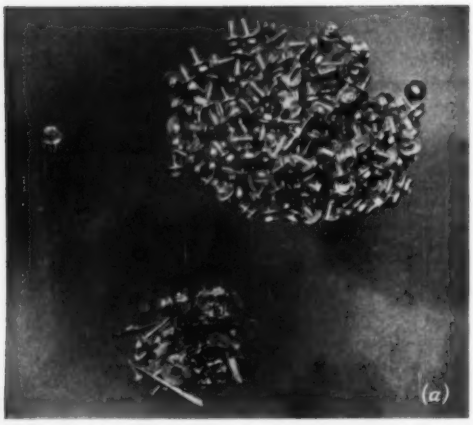
## ▶ A Case History

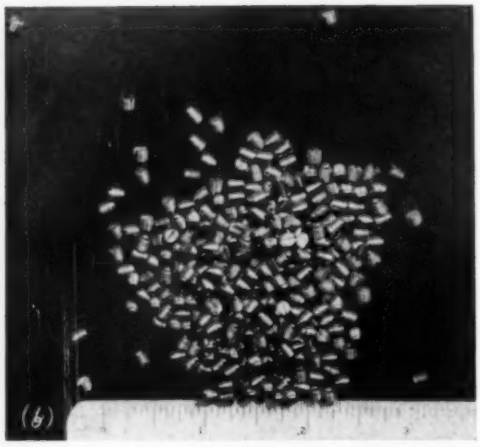
The wire contact relay, *Fig.* 2, is used in data-processing machines, computers, and missile-guidance systems. Three stages in wire contact relay assembly are shown. At left is a partial assembly as performed by the machine in *Fig.* 3. The part is cut away to show tapped hole, armature bumper, and adjusting screw. The center unit is the assembly as completed by the machine in *Fig.* 4. Completion of the relay, as shown at right, is manually accomplished. The only components not assembled by the two machines are the contact wires and the coil terminal wires.

To successfully automate the assembling of this device, a detailed analysis of component quality and thorough consideration of possible causes for machine station failures were required. But despite this careful planning, early experience with the prototype machines proved that designing to blueprint specifications of the component parts was not enough. Human reliability was conspicuously absent, and various means of coping with the problems were devised in order to achieve full success.

Since the assembly had been accomplished manually for about a decade, reasonable satisfaction with standard sampling procedures had been experienced in regard to component quality. Assembly personnel, by their very skill and experience, were quick to detect a stray substandard part undetected by standard sampling measures and knew better than to include it in the assembly. Contaminants mixed with bulk components were routinely left in tote pans and discarded.

The automatic assembly machines, on the other hand, tried to process anything they were given including paper, wood, string, oversized and undersized parts, broken parts, bent parts, and even



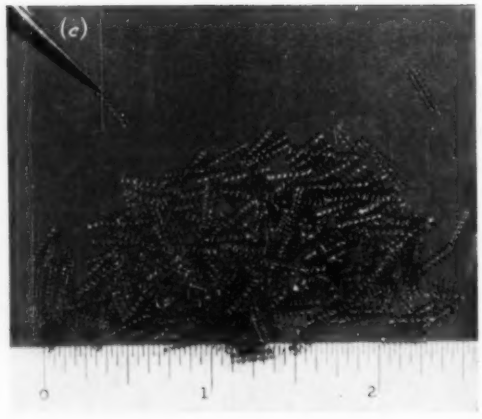




**Fig. 5—Typical metal parts which can cause problems in automatic assembly are (a) assembly screws, (b) adjusting screws, and (c) springs. The illustration of assembly screws also shows the variety of foreign material which can be mixed in with the desired screws if quality control in vendor's plant is below par.**

the wrong parts, if allowed to get into the hoppers. Here was a challenge to Quality Control personnel to improve the quality level of components, not only from the standpoint of part-print specifications, but from the standpoint of contamination as well. The challenge was similarly directed to the designers to invent ways of circumventing these conditions in the next generation of machines.

When the assembly machines became operational, the people who did the work manually were reassigned. They are no longer available to do the work, should the machines break down. Spare machines to sustain production while others were being repaired would have been an economic burden. The importance of quality in designing, building, developing, and selecting of components for such machines, therefore, deserved better than average attention.

In an effort to provide operational prototypes with maximum reliability, many precautions were taken to make the machines error-proof. In anticipation of what could be expected, certain monitorial functions were included in the machines, specifically, to ensure corrective action when failures occurred, *Fig.* 3 and 4.

Despite these precautions, the machines could not compensate for all discrepancies. Providing controlling measures for all conditions on all components would have resulted in cumbersome pieces of equipment. Corrective effort beyond the precautions taken had to be concentrated at the source.

## ▶ Typical Problems

In the assembly of the relay, there are 12 components or subassemblies which of necessity meet stringent quality requirements. Despite a high level of quality in these components, the attempt to assemble such parts automatically was hampered by contaminants or conditions in the parts which skilled assemblers formerly disposed of. For example, there was a problem involving assembly screws pictured in *Fig.* 5(a). An approved lot of screws was causing station failure. In the course of troubleshooting the problem, we found unthreaded screw blanks, screws without washers, loose washers, wood screws, miscellaneous screws of other varieties, and even chips. Many of the conditions were traced to suppliers. The effects of such contamination demanded serious attention.

In the case of "foreign" screws, we found that much of this was due to the failure of the supplier to properly clean his plating barrels before processing our order. We had no trouble with this condition during manual assembly because assembly personnel disposed of such contaminants as a matter of routine. We became quite fussy about our "simple" assembly screws, and an understanding with our suppliers alleviated the problem.

Problems with adjusting screws, also shown in *Fig.* 5(b), were essentially similar to those experienced with the assembly screw. They are much smaller parts and smaller pieces of foreign matter were more troublesome. Besides contaminants, we found unslotted screws, particles imbedded in the slots, and off-center slots which prevented the driver

from engaging properly. The automatic machine had no way of coping with these conditions, and machine-station failures occurred until the conditions were corrected.

In manual assembly, this condition was appropriately handled by assembly personnel. The solution called for greater control in processing and handling, and again co-operative effort from our suppliers alleviated the problem considerably.

In the case of the springs, *Fig.* 5(c), we had to ask for finish specifications in excess of that required from a functional standpoint. This was occasioned because, to insure a satisfactory assembly, it was necessary to probe for the presence of these springs. Mechanical methods of doing this proved to be undependable. Proximity devices presented circuit problems. A photoelectric system was finally decided upon, but the reflective quality of the spring wire was inconsistent. After obtaining a finish with the high level of reflection necessary for photoelectric pickup, our probing device worked very nicely.

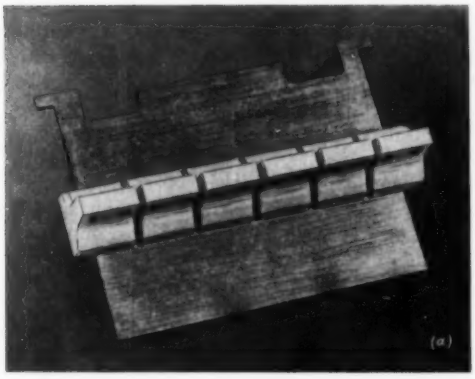
The relay armature, *Fig.* 6(a), is a precision metal stamping on which plastic blocks are molded. The blocks have spaces between them so that when the plastic shrinks, following the molding operation, it will not affect the precise flatness of the metal stamping. The machine was designed to accept parts according to print. When we proceeded to feed parts from one particular mold, we found that the spaces between the plastic blocks were too narrow to ride on the feed tracks.

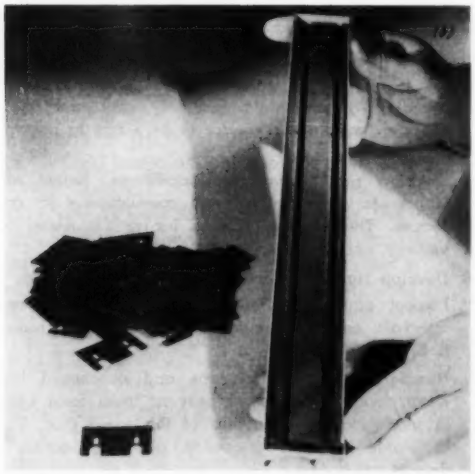
Our Quality Control people informed us that since this dimension was nonfunctional, an off-specification had been authorized when an error was found in the vender's mold. Of course, steps were taken to have this condition promptly corrected. In the meantime we had to manually assemble all such armatures which were in stock, because of the failure to investigate for the existence of off-specifications.

Another point we failed to consider in our original design was the problem created by flash between the plastic blocks. Naturally, the part print did not show this, and we experienced trouble in feeding parts as a result of it. We changed the plating specification of the stamping to facilitate the removal of the flash and obtained a superior part at less cost because of the resulting economies in flash removal.

The material for the contact wire holder, *Fig.* 6(b), is laminated phenolic and is produced in sheet form. The part is stamped from strips made from the sheet stock. The number of end pieces, consequently, is substantially greater than the number of end pieces produced from a continuous roll of strip stock, and occasionally the end piece stamping involves insufficient material. The end pieces resulting in partial parts presented no problem in manual assembly since they were routinely discarded by assembly personnel. The machine, however, had no way of determining that a part was not complete and would try to feed the partial part and thus cause the station to misfunction.

Problems also resulted from bowed parts made



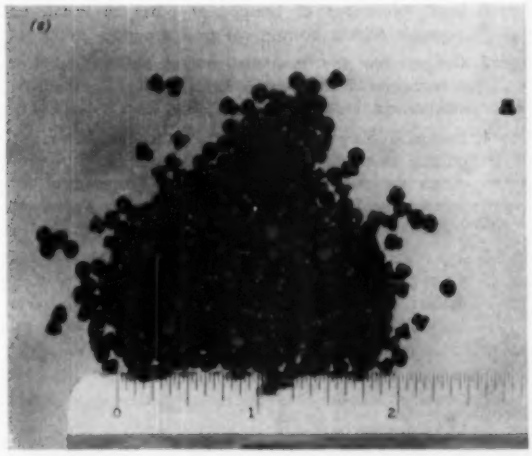



**Fig. 6—Special parts required for the assembly of the relay include (a) relay armatures, (b) contact wire holders, and (c) rubber bumpers. Flash on molded plastic and rubber parts created a problem in feeding. The stacked pack of plastic stampings in (b) enables faulty parts to be easily spotted and also serves to orient parts for use by automatic assembly machine.**

from warped sheets. These would bind in the feed track, resulting in serious jams. Bowed parts could be satisfactorily handled in manual assembly because the condition presented no functional problem once the part was secured in place.

In our efforts to provide parts which were satisfactory for automatic assembly, we called for a flatness specification which was easy to attain, but difficult to check. Automatic inspection methods were hard to justify. As an aid to inspection, we went to "stack packs" as shown in *Fig.* 6(b). This enabled immediate spotting of broken or deformed parts which could be easily extricated before being fed to the machine. Another advantage of this type of packaging is that the parts could be deposited into the feed chute directly from the container, thus eliminating the need for vibratory feeders with elaborate orienting devices.

The bumper, *Fig.* 6(c), is a molded rubber part. Flash is not only undesirable but creates serious feeding problems in automatic assembly. Binding in the feed mechanism caused the machine to stop. Thorough flash removal was required before automatic assembly could be satisfactorily accomplished, thus ensuring that only superior components were getting into the assembly.

## Functional Disorders

An assortment of other conditions might have been experienced in the development of these machines, but those mentioned above are good examples of what one can encounter. The important point is that such conditions are very apt to exist and have to be given appropriate consideration early in the engineering phase of any automatic assembly machine. Equally important is that the measures required to deal with these conditions must be adequately considered in the economic and qualitative evaluation of the proposed equipment.

Station failure for causes other than component conditions may be inherent in the design logic or the mechanism itself. Usually, in properly engineered machines this is not the case. Functional disorders causing machine-station failures are typically due to: 1. Improper adjustment. 2. Excessive wear between bushings and guided members. 3. Worn or broken tools. 4. Obstructions in feed tracks. 5. Pneumatic or electrical failures. 6. Wear in station linkage. 7. Wear in fixtures.

Whatever the causes for station failures, they still must be taken into account in evaluating reliability. Inferior components, contaminants, and faulty machine stations may cause automatic assembly machines to fail. If the causes of such failures can be effectively minimized, they augment, in reality, the economic advantages of the machine. By failing, the machines serve as ruthless inspection devices which ensure a superior product at less cost. Inferior assemblies are brought to the attention of the operator, and they can be appropriately reworked or discarded.

The ultimate in production, however, is distinctly related to a conscientious consideration for quality at the outset. Only by increasing this important factor, both in components and machines, can the automated factory become an economic reality. The effort required must come directly from the engineers concerned.

### Considerations For Development of Automatic Assembly Machines

1. Analyze quality requirements thoroughly. Develop statistical charts, if necessary, to show the extent of deviations before undertaking the design of any machine station.
2. Limit tolerances of component parts as much as possible within economical and practical limits.
3. Design into the machine monitoring methods for detecting and eliminating failures. Use electrical or mechanical station "lock outs" to sort defects.
4. Design quality control into the machine. Automatic gaging methods, machine cycle counters, and precision switches can often provide this control by monitoring for conditions which are conducive to failure.
5. Maintain adequate vendor relations in the case of purchased parts. Be sure that there is a thorough understanding regarding acceptable quality levels on all shipments. Quality specifications should accompany part prints on initial orders at least, and should be made a part of the purchase contract.
6. Develop vendor relations so that a thorough understanding of automatic assembly problems exists. Co-operate with the vendor to help him to improve his quality.
7. Develop rigid acceptance conditions. Reject any shipments which fail to meet specifications for any reason. This may require a larger sustaining inventory but it has its compensations.
8. Develop rigid in-process quality-control methods.
9. Inspect gages and tools at regular and frequent intervals, especially before and after each production run.
10. Number all production runs and purchased lots. Keep them separated to prevent them from overlapping into other batches of the same part. This facilitates "blanket" rejection and segregation if defects are found.
11. Keep statistical records of all shipments from vendors. This helps to ascertain the quality of the vendor's product so that he may be favored with subsequent orders accordingly.
12. Do not take quality for granted.

# WIREBOUND BOX CLOSER SPEEDS INSULATOR PACKING

EQUIPMENT for automatically squaring and closing wirebound boxes has eliminated a bottleneck at the packing station for high voltage suspension insulators in a plant of General Electric Co. In a former packing method, operators had to manually close the wire loop fasteners of the boxes after loading them with insulators. The slowness of this operation sometimes caused overloading of the packing station so that about 8 manhours a week of extra labor were required to remove incoming insulators from a packing table, stack them on pallets, and return them to the table when the workload permitted.

With the box closing machine, packing manhour requirements are about 20 per cent less and bottlenecks do not occur at the packing station. In addition, the boxes are stronger and better squared, and may be stacked seven-high on pallets instead of three-high as before. Another advantage of machine closing is that the wire loops are uniformly pressed flat against the sides of the boxes, reducing the possibility of accidental opening of the boxes during subsequent storage and handling.

At the packing station, *Fig.* 1, an operator selects a flat box blank from a stack and places it so that the two center sections of the blank nest in a V-shaped fixture. He then takes from four to eight insulators from an adjacent conveyor and places them in the pocket formed by the center box sections. During this operation, the operator strings the insulators together and hooks the end units in the string into cleats at the ends of the box sections.

When a box is loaded, the operator closes the remaining two sides and threads (but does not bend) the wire loops in place. He then operates a pneumatic foot valve and the fixture rotates 45 degrees to place the box in a horizontal position. One side of the fixture is in the form of a roller conveyor section. When horizontal, this side provides a track for moving the box into the closing machine.

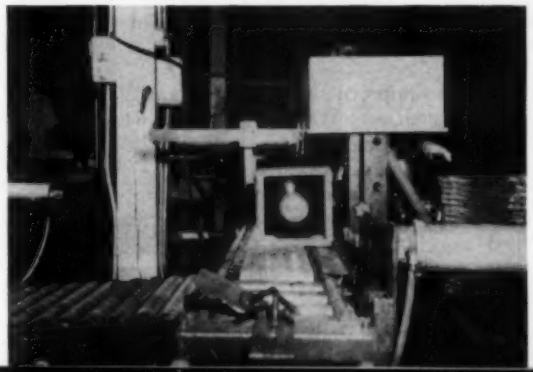
As the box enters the machine, it is picked up by a continuously moving belt and advanced into a cage of top and side bars that hold the box in approximate shape. A limit switch at the input end of the machine is actuated by the leading edge of the box. This initiates a time delay cycle that begins when the box passes beyond the switch. During the delay period, a stop is advanced to hold the box stationary, and a box-closing cycle is completed.

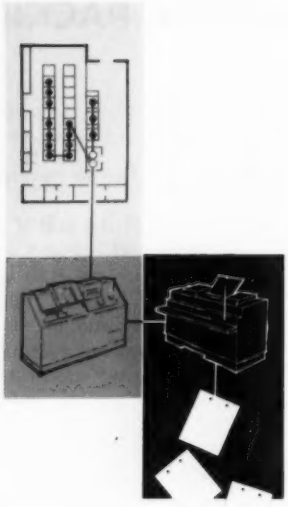
In the first step of the closing cycle, *Fig.* 2, the box is clamped and squared between the side bars. Then, a loop bender bar is moved downward on an arc, folding the wire loop fasteners against the side of the box. After it has closed the box, the bender bar returns to its normal, overhead position. The box is then unclamped from between the side bars. Retraction of the stop completes the closing cycle and the box is then free to continue on the belt.

When the box leaves the end of the belt it passes onto a roller conveyor section and actuates an air valve. This cycles a set of cross-feed rolls and a pusher cylinder. The cross-feed rolls rise between the rollers of the conveyor section and lift the box. The pusher cylinder then advances, pushing the box at right angles to the closing machine belt. An inclined roller conveyor carries the box to a pallet area. Lowering of the cross-feed rolls and retraction of the pusher cylinder rod complete the transfer cycle.

**Fig. 1—Operator at packing station for high voltage suspension insulators loads parts into semiformed wirebound box in fixture. He then closes the box, threads the wire loop fasteners in place, and pushes the box on rollers into closing machine, background, developed by Stapling Machines Co.**

**Fig. 2—Box in closing position has been clamped between parallel guide bars that square up box cross section. Bender bar at upper righthand corner of box then swings downward, pressing wire loops against sides of box. After it is closed, box advances to transfer mechanism, foreground, and is pushed at right angles onto roller conveyor by air cylinder.**





# PRODUCTION DATA SYSTEM

## IMPROVES MANAGEMENT CONTROL

FOLLOWING a 2-year study, Norair Div., Northrop Corp. has combined a production data system and a large scale computer to establish a fast, accurate, and efficient production control system. Among the areas in which the company specializes are: Weapon system management; design, development, and production of military aircraft, missiles, and associated ground support equipment; and subcontract production of major airframe parts. The division's research, engineering, and production facilities total nearly 2 million square feet. In the fabrication shops some 35,000 items might be found in various stages of production—and some 30,000 production orders might require handling each day. The company's target for improved production control was the fabrication shops.

Of direct interest to large companies faced with a similar paperwork load in their production departments, the operation of Norair's system is also of interest to small firms because it illustrates the techniques and essentials that lead to a practical system. The fundamentals of the system include: Use of a basic data document containing certain mechanically coded fixed data associated with an order; convenient means of adding variable data by shop personnel; collecting of all data for reduction and reports in a form suitable for direct machine handling; and summarizing of data and preparing of reports fast enough to permit corrective action to be taken.

Major equipment items involved in the data handling system are: Transmitting units with the capability of reading and transmitting data contained on an edge-punched card and with the means for adding variable numerical data to the transmissions based upon the position of 15 dials; receiving units and associated time code emitters that accept the transmitted data from several of the transmitters and record it in punched tape form along with the time of transmission; and an IBM 704 computer center that includes magnetic tape input and output units, high-speed printers, and conventional tabulating devices for tape-to-card and card-to-tape conversion. The transmitting, receiving units, and time code emitters are elements of the Collectadata—a data collecting system developed by Friden Inc.

The production order that is released to the shops contains an edge-punched serial number. Whenever information affecting the order—receipt of materials, who is handling, when placed in work, etc.—is to be recorded, the master order is placed in a transmitting unit and appropriate dials are positioned. For convenience of reporting personnel, 97 transmitters are located throughout the plant's 27 manufacturing shops. The various transmitters are connected by a network of telephone cables to 20 receiving units stationed in central locations. The receiving units are equipped with an automatic lockout feature that prevents a transmitter from starting simultaneously with another or breaking in while another is operating.

By the end of an operating day, a wide range of production data related to individual order serial numbers is collected on the 8-level punched tape at the receiving units. The punched tapes from the units are forwarded to the computer center where the data is first transferred to punched cards and then to magnetic tape. Between midnight and 7 a.m., information from the shops, notices of planning changes, and shortages noted by terminating stock rooms are processed by the computer, resulting in an updated master in-work file stored in the computer memory. Subsequently the computer prepares a magnetic tape that is fed to the high speed printer

for report preparation. During normal hours the computer center is engaged with engineering and scientific problems.

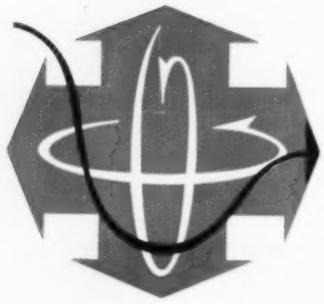
Both daily and weekly production control reports are issued. For example, a daily Zone Shortage and Aging Report is prepared to call attention to immediate problems requiring attention. Weekly reports include: A Basic Labor Report; Production Order Status Reports (this group includes serial number status, sales order and production order reports); Shop Loading Reports (this group includes summary of manufacturing operations, shops affected, and estimated standard versus actual hours); Shortage Reports (this group includes information such as section forecast, part number by sections involved in manufacturing, and terminating shop reports); and various miscellaneous reports (for example, sales order close-outs).

Besides the savings realized by eliminating many clerical functions performed by shopworkers and foremen (more than 425 man hours are saved each day), substantial savings will be realized by the reporting technique. For one thing, a dozen reports, formerly thought necessary, have been eliminated. As another example, by reporting labor automatically, 42 per cent of manual key punch time formerly required for the machine processed report has been eliminated and a more timely labor report obtained. As another example, the daily Zone Shortage and Aging Report, by indicating new shortages and controlling work in each zone by priority and age, reduces lost orders and special expediting effort.

Internal communication is a general problem in all manufacturing operations; in certain cases internal communication becomes a critical problem. Where information must be accumulated in one place from scattered sources, the data reporting system described in this article points the way to solving the communication problem, providing as it does a means of bringing management closer to production operations in terms of time, accuracy, and pertinency.

Series of photographs illustrate major equipment items in production control system at Norair Div., Northrop Corp. At 97 stations throughout plant, similar to *(a)*, fixed and variable data are fed into transmitters. At 20 centralized stations, similar to *(b)*, transmitted data are automatically collected on tape punch receivers; time code emitters associated with each receiver indicate the time of each transmission. Punched tapes are sent to computer center, *(c)*, where between midnight and 7 a.m. each day, the shop data are used to update records and issue control reports.

# TECHNIQUES FOR PARTS HANDLING



**Discrete items of any nature can be encountered in manufacture. Basic handling techniques can be successfully applied in a wide variety of situations.**

**By ROBERT H. BONNER**
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Detroit, Mich.

Fig. 1—Elevating storage hopper can be used for automatically loading smaller hoppers or feeding a bulk processing operation. Model shown has a storage capacity of 8 cubic feet with 6-foot discharge height. Unit is mounted on casters for mobility. The control panel houses an electronic detector used for automatic feed control.

MANUFACTURE of component parts is presently, and will continue to be, a very competitive business in the U. S. and abroad. Many manufacturers lose business because of high production costs. Contributing to these high costs in many instances is a large expense for parts handling to, between, and away from the various primary manufacturing processes. Thus, it becomes necessary to employ the most practical means of handling parts. Usually, total costs can be greatly reduced by the application of mechanical feeding equipment, which is a form of handling automation.

The application of mechanical feeding equipment is widespread. There is hardly a mass production factory that does not have some of this equipment. However, there is hardly a factory existing that does not have need for further practical applications. This condition is especially true for relatively small production facilities. Many times these plants have to struggle along on reduced profits or lose jobs because their high parts handling costs prevent them from being competitive.

Each parts feeder application has its individual problems, and no single type of feeder offers solutions to all problems. The selection of the proper feeder for each application involves consideration of many factors. The following discussion is intended to describe some of the various types of feeders and their applications. Basically, parts feeders can be broken down into two groups: Bulk feeders and orientation-type feeders.

This article is based on a paper presented at "Fourth Conference on Manufacturing Automation" cosponsored by AUTOMATION, Purdue University, and Manufacturing Engineering Council, April 1960.

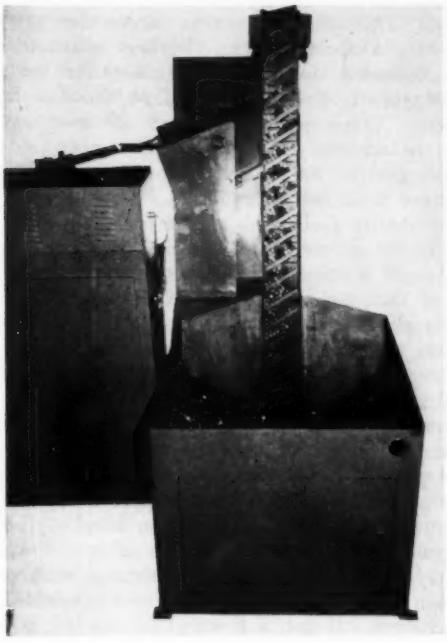


Fig. 2—Orienting belt hopper is shown feeding an automatic gaging machine, left. The orientation devices, attached to inclined exit track, are adjustable for a range of part sizes. Storage capacity of this model is 9 cubic feet.

## Bulk Feeders

Bulk feeders are machines for conveying parts in bulk from one point to another. Often a bulk storage bin is incorporated as part of the feeder, *Fig.* 1. In this case a quantity of parts, normally from 3 to 40 cubic feet, are stored in the bin. An elevating conveyor lifts parts from the bin and discharges them into other equipment, such as one or more smaller orientation hoppers. Electronic detectors sense the level of parts in the smaller hoppers and automatically control the elevating conveyor to deliver parts only when required. Thus, the application of a bulk storage bin of this type provides hours of automatic, demand-type feeding. In the application described, it also increases the efficiency of each orientation hopper since it maintains the load at an optimum level.

Bulk feeders are also used extensively for discharging parts at a controlled rate to bulk processing operations, such as heat treating or washing, or to overhead conveyors for delivery between areas of the plant. Volumetric accumulators can be incorporated which will release given volumes of bulk parts in accordance with electrical signals.

Another type of bulk feeder which is sometimes used to supply vibratory hoppers employs a conical type storage bin. This type is not common, however, since its storage capacity is somewhat limited unless a high loading height is provided. Also, it is suitable only for certain types of parts.

## Orientation-Type Feeders

These units store a certain volume of parts in bulk, and select and discharge them in a single row, all oriented the same way. There are several types of these feeders, or hoppers, namely: Orienting belt, rotary, vibratory, non-mar, and stack. For any feeder application there is usually one type of hopper that is more suitable than any of the others, although for many applications there may be more than one type which can be satisfactorily applied.

The orienting belt type hopper, *Fig.* 2, is most suitable for feeding relatively simple parts of medium size (no dimension smaller than ½ inch or larger than 3 or 4 inches). This type of hopper is very desirable since it combines a large storage facility (4 to 20 cubic feet) with an orientation facility. Hoppers of this kind are most practical for feeding processes operating at 20 to 150 cycles per minute, as is often encountered in machining, grinding, or assembling. It should be remembered that this type of hopper is suitable for orienting relatively simple shapes only, and that a certain amount of spill-back is inevitable which will scratch delicate parts. However, the units can be designed with baffling to minimize nicking and marring resulting from spill-back. Many of these units are presently

Fig. 3—Rotary hopper is equipped with a standard orientation track for rolling parts. The offset center of gravity of the part is utilized for orientation. Track is adjustable for a range of sizes, with orientation completely accomplished on the track. Rates up to 150 parts per minute are attainable with the 24-inch diameter unit.

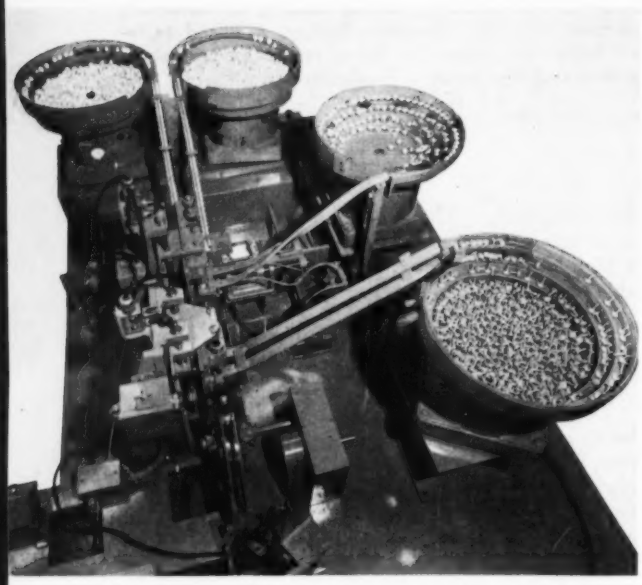


Fig. 4—Four vibratory hoppers are shown feeding various parts to an automatic assembly machine. Dual tracks are used on two of the hoppers.

in operation in the automotive, bearing, and electrical industries.

The popular rotary hopper, *Fig.* 3, has been in use for years in almost every parts manufacturing process. Various sizes are available, with bowl diameters from 6 to 36 inches. These hoppers are suitable for handling a range of part sizes up to 2 inches. They are capable of high rates of feed and will orient more complicated shapes than orienting belt type hoppers. Plastic moldings, special screws, and parts with flanges and grooves or radii can be fed. Parts are handled more gently than with the orienting belt type hopper, but not as gently as in a vibratory hopper. Rotary hoppers are most desirable when a large storage capacity is not required and space is limited. Since their cost is low, rotary hoppers are the cheapest feeders for solving simple feeding problems. The orientation features can usually be made adjustable for a range of sizes, providing a high degree of versatility.

One type of rotary hopper accomplishes orientation by using a machined selector ring. Other types perform part orientation on their discharge tracks. The latter feature is very desirable since it greatly reduces jams, provides a higher feed rate, and is extremely versatile in that the same hopper can be used to feed a number of different types of parts merely by changing the feed track. Thus, for a very nominal cost, a track-orienting rotary hopper can be converted easily to feed an entirely different part. A large capacity bulk loading hopper is often used to automatically fill a rotary hopper.

Vibratory hoppers, *Fig.* 4, are supplied in a range of sizes with bowl diameters from 6 to 36 inches. They have the ability to orient and feed parts with complicated shapes, reliably and without jamming. The vibratory action causes the parts to flow up a special track. Various orientation devices, mounted on the track, select the parts that are properly lined up and allow them to be discharged. Other parts are wiped off the track and are recirculated. The vibratory hopper feeds parts very gently. Small, delicate parts (even glass parts) have been fed satisfactorily. Since orientation is primarily performed on the track, the bowl can easily be converted for another size or type part. Larger storage type hoppers are often employed to automatically fill the vibratory hopper. Generally the vibratory hopper has a slower feed rate than a rotary type, and for some parts is rather noisy. Bowls for vibratory hoppers can be provided with multiple tracks.

The non-mar hopper, *Fig.* 5, has a unique arrangement of conveyor belts to store and orient many types of relatively simple parts without marring or breaking them. The hopper is capable of extremely high feed rates and can handle glass parts or machined parts with fine finishes. Parts are conveyed to the discharge track through various orientation devices. If a part is properly oriented it is discharged. If not, it is wiped off the belt and recirculated. The unit can be equipped with demand type feed control. The non-mar hopper is the only type which is accepted by the automotive industry for feeding finished piston pins.

Stack hoppers, *Fig.* 6, are used primarily to feed rods ranging in size from $\frac{1}{8}$ to 1 inch in diameter and from 4 to 24 inches in length. The hopper is essentially a storage box with an agitator which causes the parts to roll out the bottom in a single row. A pusher can be incorporated to discharge one part at a time to a specific point when energized by an electrical signal. Parts are loaded into the

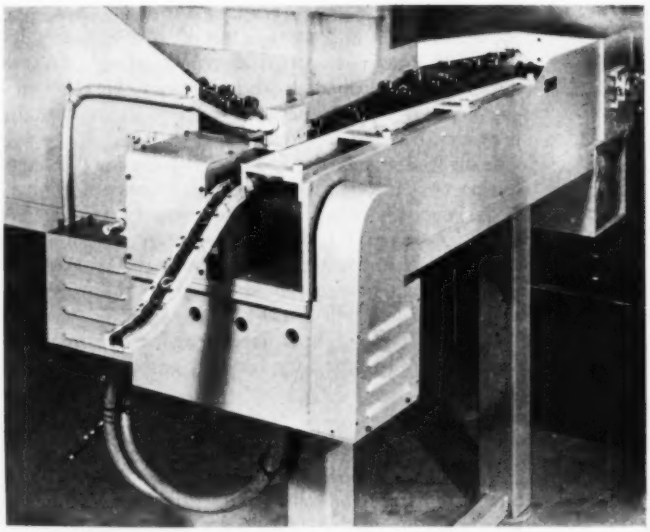


Fig. 5—Non-mar type hopper is tooled for feeding finished gears without marring. To provide demand type feeding, a parts detector shuts off the hopper when the track is full.

hopper with the desired orientation. Since the equipment is rather simple and can be made adjustable for a range of sizes, the cost is low. Thus, a stack hopper is usually easy to justify as a cost saving device.

## ▶ Principles of Orientation

The first point a parts feeder engineer studies before recommending a specific type of equipment is the method of orienting the parts. Usually he will study the part to be fed and attempt to place it into a familiar category, to which he can apply a known orientation method.

Parts such as bolts and other headed or flanged parts can best be oriented and fed by suspending them from the head. This method is relatively simple and can be incorporated in almost any type of hopper. Usually the discharge track consists of inclined rails on which the parts slide.

Another basic orienting principle considers the center of gravity of the part. If its center of gravity is other than its geometric center, the part can often be allowed to slide or roll down a track with a knife edge inclined at a compound angle. If the part is not properly oriented it will fall off the track.

Chamfers, rounded edges, flanges, or grooves are also used for orientation as illustrated in *Fig.* 7. Usually the part is supported on a knife edge or guided by a flange or groove. If not properly oriented it falls or is scraped off the orientation track and back into the storage for recirculation. Frequently, complete orientation cannot be achieved with a hopper and track. In this case, the hopper partially orients the parts and discharges them to a mechanical orienting device normally consisting of a pusher, a detector, and equipment to reposition the parts and discharge them fully oriented. This equipment is rather complex and expensive, but can often be economically justified if the processing rate is reasonably high.

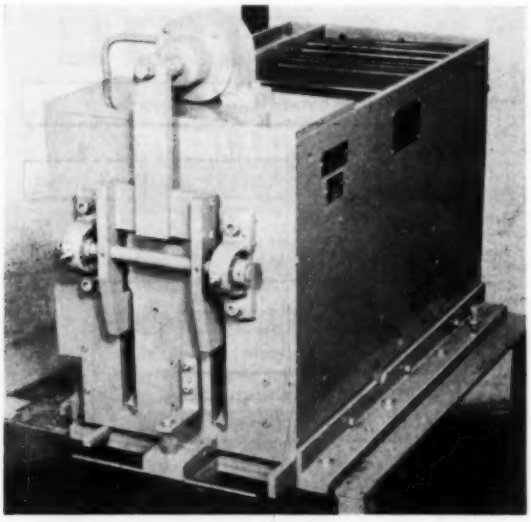


**Fig. 6—Air-operated stack hopper feeds automotive pushrods. Unit has an internal pusher that discharges one part at a time to spring loaded jaws. The hopper is adjustable to accommodate a range of part sizes.**

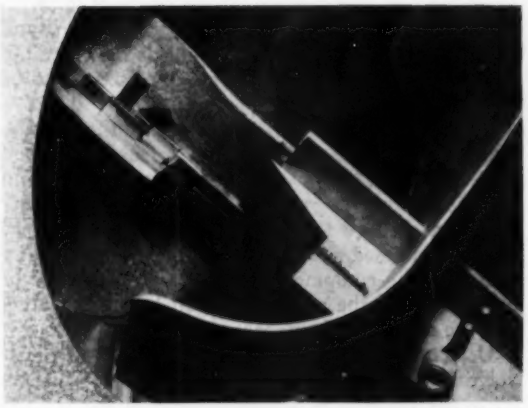


**Fig. 7—Close-up of an orientation track used for feeding small rectangular parts. Orientation is completely accomplished on the track. One side of the part has a small radius which causes certain parts to slide off a knife edge and into the rotary hopper for recirculation.**

Other factors to be considered in choosing a method of orientation and type of hopper are the necessary rate of feed, storage capacity, prevention of marring or breaking of parts, and available floor space. Often a thorough analysis of the part and its feeding requirements will bring up easily overlooked points that can later cause serious problems in manufacturing. A thorough study of the problem enables the engineer to choose the most practical method of handling a part. This is of paramount importance, since each feeder has to be economically justified. Unless the proper selection is made, such justification may not be possible.

It is advisable to consult suppliers of automatic parts feeders who manufacture complete lines of all types of hoppers. Such suppliers will have the necessary experience to recommend the best type and size hopper for a specific job.

## ▶ Handling Concepts

Most manufacturing processes involve a number of subsequent machining operations on each part. Thus, there is usually a requirement for more than one parts feeder for any one manufacturing line. There are two basic concepts used in handling parts to and between operations. The first concept involves feeding the parts from a bulk storage bin to an orienter for the first machining operation, and maintaining orientation of the parts through subsequent operations. Generally, it is necessary to provide storage between operations. Standard storage units which maintain orientation are available for many relatively simple parts. This concept is usually inexpensive, and saves floor space. The disadvantages

lie in the fact that it is not always practical to maintain orientation after a machining operation, and only a limited storage can be provided. Difficulties are also encountered when a range of sizes is to be processed.

The second handling concept involves the installation of bulk storage units with orienters between each operation. This concept is more flexible, and provides more storage between operations. Another important feature is that orientation does not have to be maintained after each operation, which greatly simplifies the equipment. The disadvantages lie in the expense of the more complicated feeding system and the additional floor space required.

Usually, an automatic manufacturing line will involve both concepts. The determining factors underlying the decision of which concept to use are the type of part, flexibility required in the line, rate of processing, and storage required between operations.

## Feeding Systems

Most manufacturing lines in modern factories employ many parts feeders. A combination of feeders to automate a line comprises a feeding system. A representative system is illustrated in *Fig.* 8. This particular system employs almost every type of hopper to attain complete automation of the line. Although this particular system may not exist, many actual systems involving virtually the same equipment are presently in use. Often, the equipment is interconnected and programmed from a master timing circuit or primary processing machine.

Another parts distribution system is of interest for its automatic operation in an existing automation line in an automotive factory. The equipment consists of a rotary orientation hopper on each processing machine, an overhead conveyor, electronic scanner, bulk storage hopper, return conveyor for finished parts, and chuting.

The bulk storage hopper stores 40 cubic feet of parts and elevates and discharges them on demand to the overhead conveyor. This conveyor is equipped with gates and down-chutes that lead to rotary hoppers. Each rotary hopper has a parts level detector. The scanner investigates each rotary hopper in sequence. If a hopper needs parts, the gate on the overhead conveyor is closed and parts are delivered to the hopper. The scanner then proceeds to the next hopper in the line. The return conveyor accepts parts from the machines and conveys them to the next operation.

Distribution systems, although quite expensive and complex, have proved to be great cost savers in many high production lines. It is possible to automatically feed up to 25 machines with one system.

## Economic Justification

Usually, parts feeders are easily justified economically if the parts lend themselves to mechanical handling. As an indication of price, if a part is relatively simple, a hopper with reasonable storage (4 cubic feet) can be provided, orientation accomplished, and discharge track furnished for about $3500. This is usually easily justified from a labor savings point of view. Often, a rotary hopper and orientation track can be supplied for about $600. This provides an extremely low cost method of feeding parts.

Elaborate parts feeding systems can also be quite easily justified economically, even though their total cost may run over $100,000 in certain instances. In fact, many manufacturers of high production parts find it mandatory to employ these systems for competitive manufacturing. The alternative may be to accept reduced profits or lose business because of high parts handling costs.

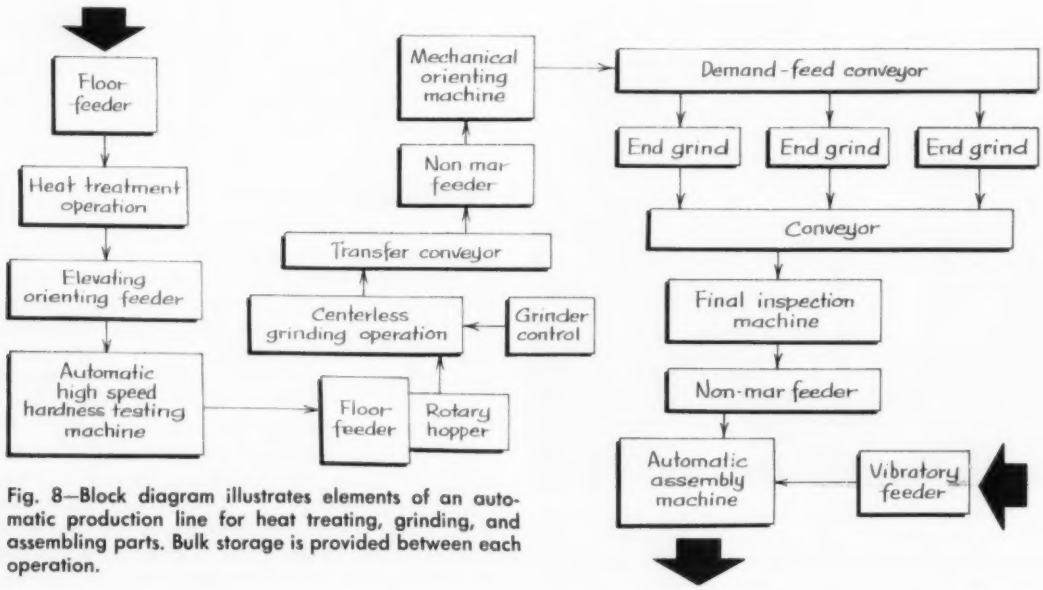
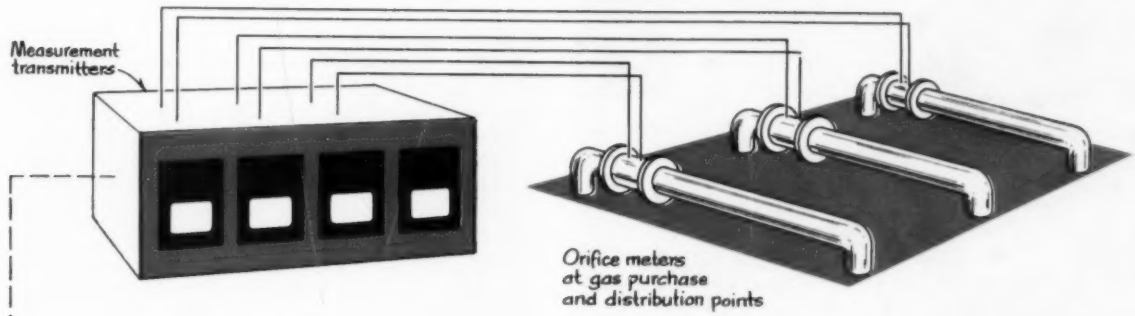


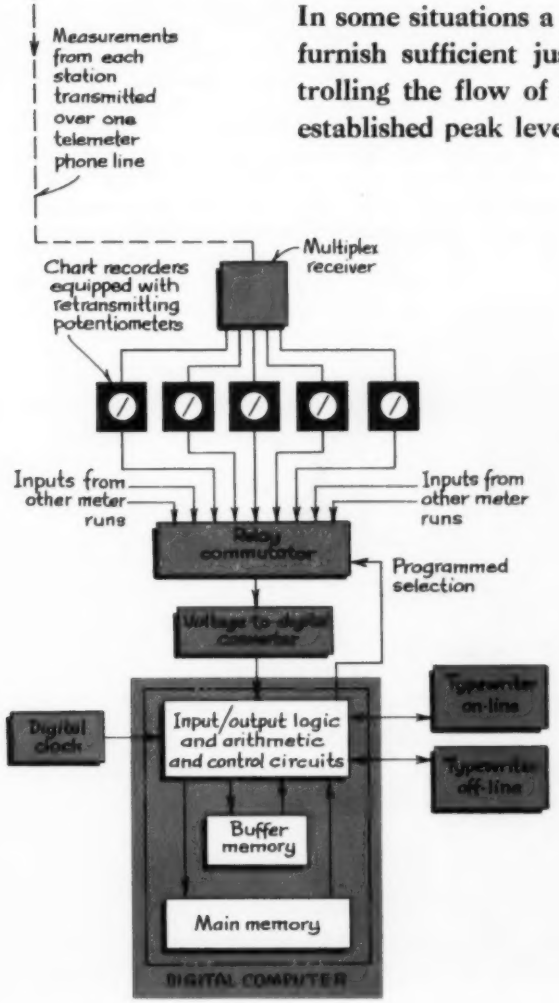

**Fig. 8—Block diagram illustrates elements of an automatic production line for heat treating, grinding, and assembling parts. Bulk storage is provided between each operation.**




# COMPUTER MONITORS FLOW VARIABLES

## IN GAS DISPATCHING SYSTEM

**In some situations a necessity for speed in making decisions can furnish sufficient justification for installing a computer. Controlling the flow of natural gas in a utility system, so that an established peak level is not exceeded, is one of these situations.**




KEY to success in attempting to optimize process control is the development of a system which can collect data reflecting variations in the process, analyze the data in terms of a predetermined method of operation, and display the results of the analysis in time to permit corrective and optimizing action. When large numbers of variables are involved, the factor of time is especially important. Time lost in collecting and analyzing

**Fig. 1—Diagram illustrates the major operating elements of the electronic data handling system for monitoring gas flow. Pressure and temperature measurements are collected at remote gas purchase and distribution points and telemetered to a central dispatching station. Multiplexed data are separated and distributed to individual chart recorders for permanent records. Retransmitting potentiometers mounted in the recorders are selectively connected to the voltage-to-digital converter where data are converted to digital signals. These signals are used by the computer to perform various gas flow calculations needed to maintain gas flow under an established peak demand figure. During periods when the computer is not required for flow calculations, a digital clock switches the system to performing engineering calculations for other departments.**

Fig. 2—This is one of the many orifice metering stations in the system. In the left background can be seen three parallel meter runs from which measurements are taken. In the right foreground is a weather-proof meter compartment which houses the Bristol Co. Metameter transmitters. All measurements collected at this station are transmitted to a central dispatching station over one telemeter phone line, using a multiplex system.

data used to make control decisions results in possible losses in quality, reliability, efficiency, and safety of the process.

For a relatively slow process, manual methods of data collection, analysis, and decision suffice. However, as the tempo of the process increases, the element of time between process change and effective process correction decreases until a point is reached where optimization necessitates fast and automatic data handling and control. Such is the case at the Public Service Co. of Colorado which delivers over 100 billion cubic feet of natural gas to customers in Colorado and Wyoming each year.

The utility company purchases gas from suppliers having gas fields in Kansas, Oklahoma, Texas, New Mexico, and Colorado. The cost of the gas to the utility is determined on the basis of a commodity charge and a demand charge. The commodity rate is a basic charge for each cubic foot of gas delivered. The demand rate is based on highest amount of gas delivered during any one day in an 11-month period preceding the current 11-month period. Should a higher peak demand be established on any one day during the current period, the demand rate is increased for the next 11-month period.

The utility company controls gas usage on high-demand days by interrupting service to certain industrial customers who obtain preferential rates by agreeing to curtail use if gas demand approaches a previously established peak. To determine when service should be interrupted to these customers, gas usage is continuously monitored at a central dispatching station on a 24-hour basis. Differential pressure, static pressure, and temperature of gas at various metering stations in the system are telemetered to central dispatching and recorded by Bristol Co. circular chart instruments. Prior to installation of automatic data processing equipment, a Gas Load Dispatcher read the charts each hour, manually calculated the gas flow at individual metering stations, and totaled the flows to determine the system demand. Due to the number of readings and the complexity of calculations, this manual determination required 30 to 45 minutes out of each hour.

Gas demand varies according to weather conditions, industrial activity, time of day for home heating and cooking, and other factors; and the dispatcher must weigh these variables against actual gas flow when usage approaches the established peak demand. To eliminate the time differential in determining the total system demand, the utility company has installed a computer-control system to monitor flow data, perform calculations, and print out demand totals for the dispatcher. Heart of the system is a LIBRATROL-500 computer, manufactured by Librascope Div., General Precision Inc., which performs gas flow calculations 10 times each hour. Each calculation requires approximately 1.5 minutes. The remaining computer time is available for other engineering calculations.

Flow data for the computer are provided by the existing circular chart recorders. The Bristol instruments are fitted with retransmitting potentiometers which generate output voltages propor-

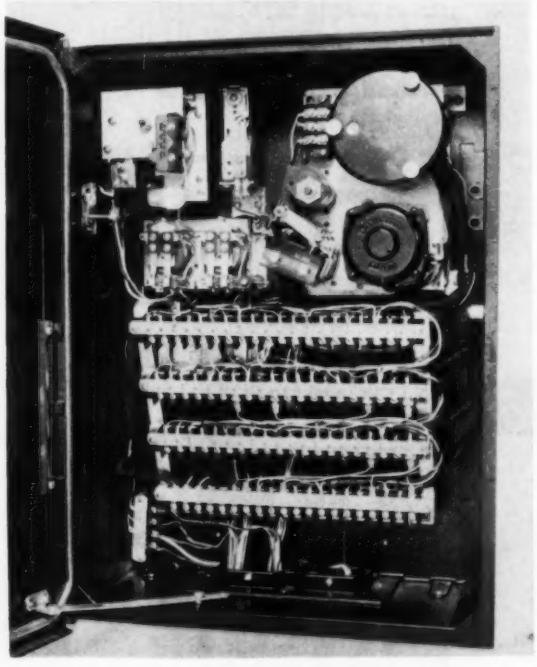


Fig. 3—At the central dispatching station, the multiplex receiver shown collects the measurements transmitted from the remote stations and distributes them to individual chart recorders.

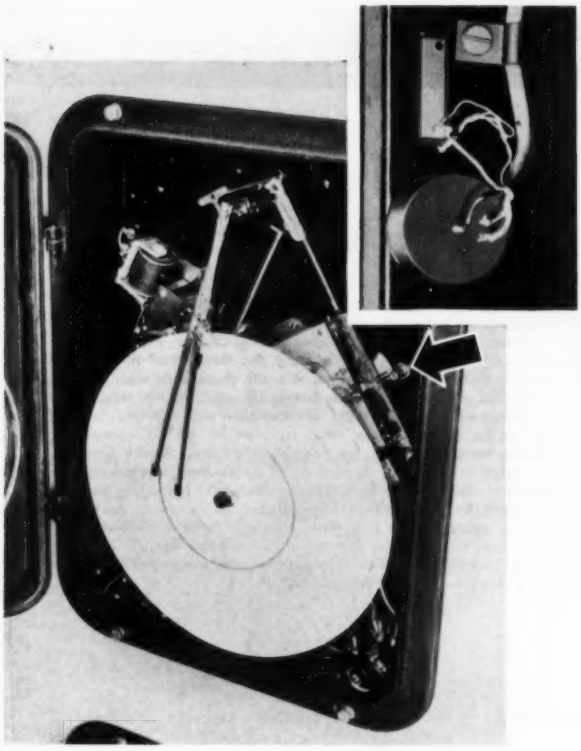


Fig. 4—This view shows one of the Bristol Co. chart recorders in the central dispatching station. The arrow points to a gear and pinion that moves in synchronization with the chart pen and actuates a retransmitting potentiometer mounted on the rear of the recorder case. Inset gives a close-up view of the potentiometer.

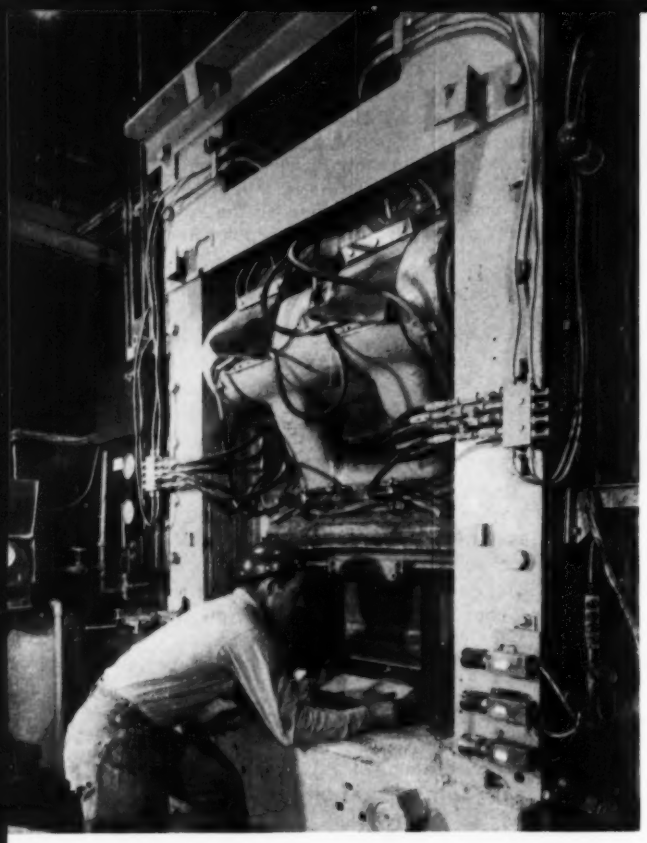
tional to the value indicated at each recorder. The potentiometer outputs feed to the computer system voltage-to-digital converters for conversion into digital signals. These signals are then fed directly into the computer.

At the metering stations, gas flow is measured through orifice meters. Instantaneous flow through each orifice meter is determined by multiplying the orifice flow constant by the square root of differential pressure times static pressure. The computer is programmed to collect the differential pressure, temperature, and static pressure measurements for each metering point every 6 minutes; determine the flow rate and total flow for the 6-minute intervals, and store the results. At the end of each hour, the computer totals the flow in cubic feet per hour for each meter. Automatic typewriters print the results along with the total gas flow during the hour and the accumulated gas flow to that particular meter run in a 24-hour period.

The speed at which the system can complete the monitoring and calculating necessary for flow determinations allows the computer approximately 4.5 minutes out of every six for additional computing tasks. To take advantage of this available off-line time, the computer is programmed to handle problems, such as the analysis and design of gas distribution systems, or billing preparation. A digital clock reference is used to switch the computer between the primary and secondary programs at the appropriate time periods in each hour.

Installation of the LIBRATROL-500 system has relieved dispatchers of the burden of manual calculations and related clerical activities. The computer performs all routine repetitive tasks, enabling dispatchers to devote more time to evaluating weather predictions and to making important decisions required for equitable distribution of gas to customers with interruptible-service contracts.

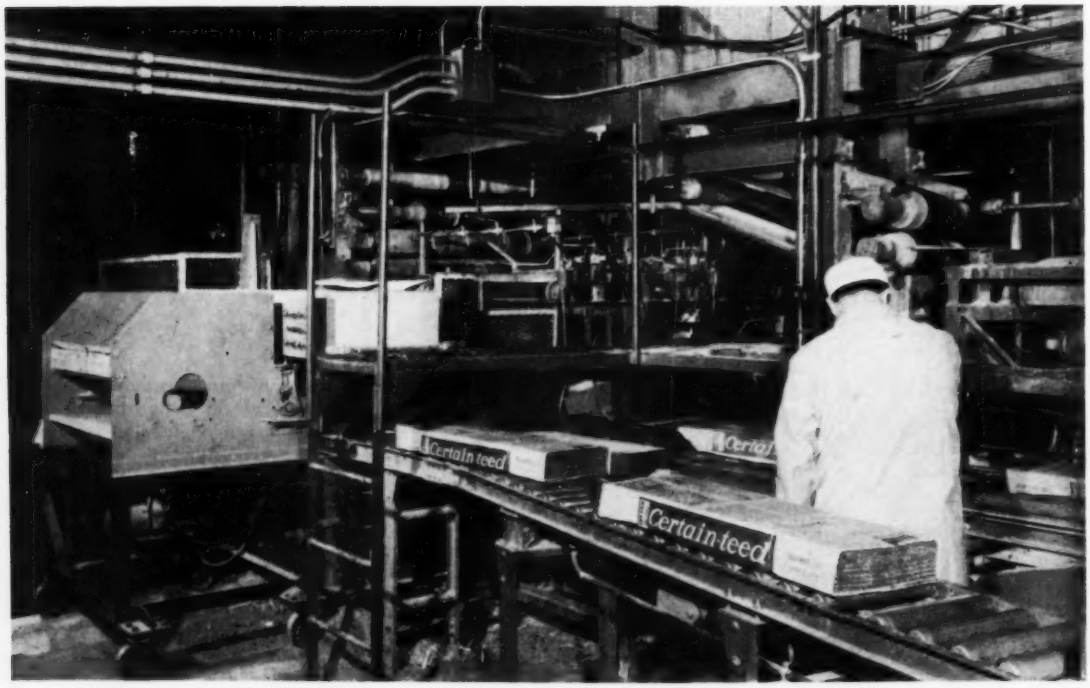
Fig. 5—From the chart recorders in the background, data are transmitted through a relay commutator and voltage-to-digital converter to the LIBRATROL-500 computer in the foreground. Every 6 minutes the computer determines the flow rate and accumulated flow total at each remote metering station and stores the results. The flow in cubic feet per hour for each meter is totaled by the computer at the end of each hour and printed out on the typewriter at the left. The other typewriter is used for computer input and output when the unit is used for off-line engineering calculations.



# automation

## Pressing Bricks

PRODUCTION of wedge-shape bricks at the Moss Landing, Calif., plant of the Refractories and Chemical Div., Kaiser Aluminum & Chemical Corp., requires constant starting and stopping of this 1000-ton press so that the operator can handle the shape with ease. Manually operated mechanical clutches previously used on the press required adjustment every 16 hours of operation and complete overhaul every six months. These were replaced by an air operated clutch-brake manufactured by the Fawick Airflex Div., Fawick Corp., which resulted in a production increase of 25 per cent and a virtual elimination of clutch maintenance. The clutch-brake is now under push-button control by the operator and includes an automatic braking system as a safety feature. The three photoelectric units mounted on the right side of the press automatically disengage the clutch and engage the brake when their light sources are interrupted by the operator's hand or other extraneous objects.



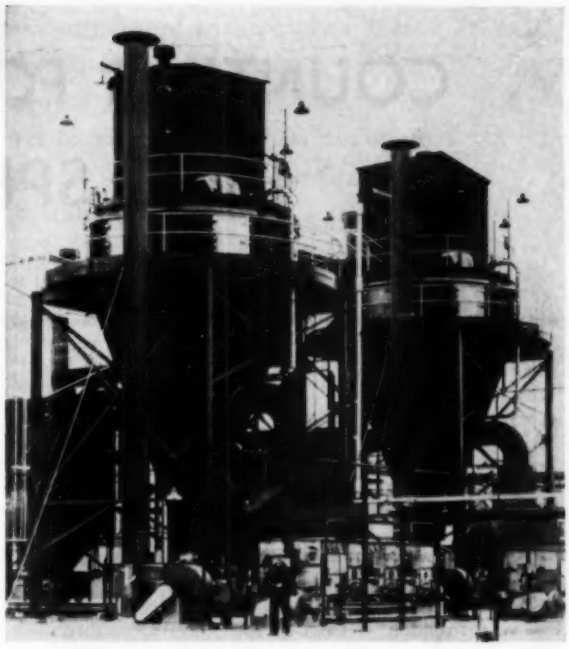

## Bundling Shingles

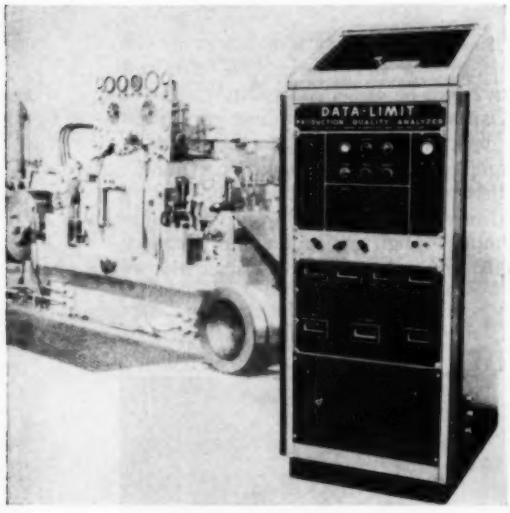
INTEGRATED shingle packaging equipment in the Ardmore, Pa., plant of Certain-teed Products Corp. receives shingles from the cutting end of a shingle manufacturing machine, automatically stacks them into bundles, applies a corrugated wrapper, and delivers the bundles to an automatic wire tier. The equipment automatically adjusts to handle different sizes and designs of rectangular shingles, inverts shingles in any predetermined pattern, and varies the number of shingles per package. Developed at the Research and Engineering Laboratories of Certain-teed, the packaging equipment will be installed in seven other plants of the roofing materials manufacturer.

# in action

## Drying Plastic

HEAT sensitive plastic is gently dried from wet cake to free flowing powder in these two spray-dispersion dryers at a Michigan plant of Dow Chemical Co. The units are equipped with atomizers of a special design which permit feeding of an unconditioned wet cake. As the atomized material falls inside the units, the plastic is dried to a final moisture content of less than 0.1 per cent without recycling. No subsequent grinding or screening is required. The equipment was provided by the Nerco-Niro Spray Dryer Div., Nichols Engineering & Research Corp.



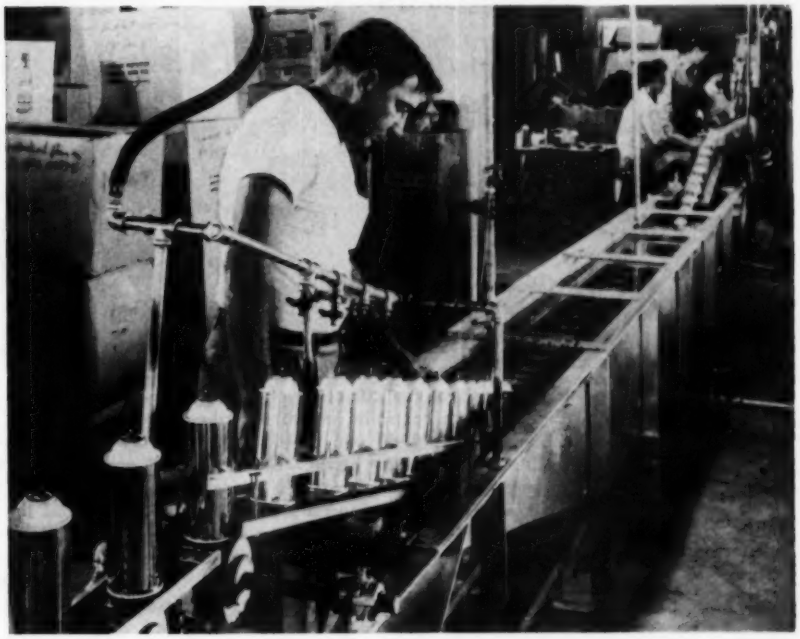



## Classifying Metal Strip

QUALITY control equipment developed by Pratt & Whitney Co. Inc. classifies rolled metal strips into undersize, good, or oversize lengths; counts the number of feet of strip within each category and total footage; and makes a printed record of the classifications on tape, either singly or in duplicate. The printed tape also shows the coil number; year, month, day, and hour coil was run; and the plus or minus tolerance. The equipment can be connected to any type of Pratt & Whitney continuous thickness gage such as x-ray, beta-ray, Electrolimit, or magnetic and will accurately check strip running at speeds up to 2000 feet per minute. The sloped-front console cabinet for the equipment was furnished by Elgin Metalformers Corp.

## Handling Aerosol Cans

MAGNETIC conveyor is used at Southwestern Packaging Co. to transport filled aerosol cans through a heating bath. Previously, the company had experienced difficulty in preventing the cans from falling or floating off an underwater nonmagnetic stainless steel belt conveyor. A solution was found by installing permanent magnet units manufactured by Eriez Mfg. Co. under the belt so that the cans are securely held and controlled as they move through the bath. The new system permits continuous operation without the necessity for constant operator inspection. Different sizes of containers can be processed without changing equipment.



# COUNTING FOR HIGH SPEED CONTROL

By JAMES E. EVERETT, President, Dynapar Corp., Skokie, Ill.

ELECTRONIC counters have been used for many years in high speed totalizing applications. However, industry's continual requirements for greater productivity at lower operating costs have led to the development of automatic control as a function of high speed electronic counters. This added function has extended the utility of electronic preset counters from laboratory and very specialized applications to everyday industrial production operations. Therefore, since the original counting function is now merely a means to an end —automatic control—a more descriptive term for this component might be preset controller.

A major advantage of electronic preset controllers is their high operational speeds. Standard models can operate from zero to 180,000 counts per minute and can be instantaneously reset with no loss of count. Special models will handle up to 4.5 million counts per minute. High resolution and accuracy at these speeds are outstanding characteristics of

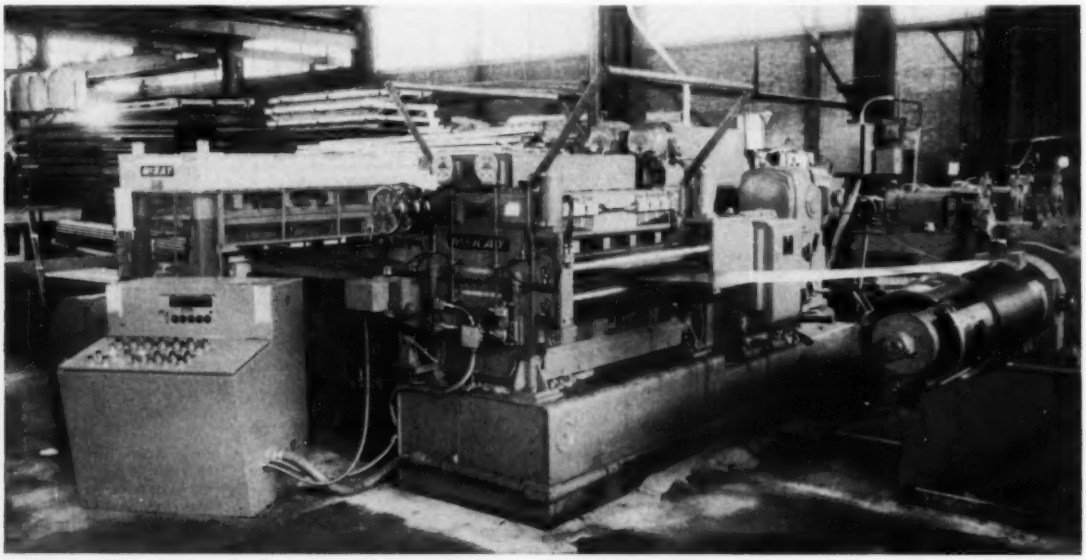


Fig. 1—This power shear for cutting steel sheets from coiled stock is controlled by an electronic digital length controller mounted in the console at the left. A rotary sensing device is mounted directly on one of the roller shafts and generates 100 pulses for each linear inch of material travel. The controller accumulates these pulses and actuates the shearing mechanism when a preset length is reached. Operation is continuous until a separate electromechanical counter has registered the total number of sheets in this batch. Then, the controller is manually set to a new cutting length. Although readout is unnecessary in this application, glow counter tubes at the control panel provide numerical indication of material footage. The McKay Machine Co. power shear is installed at Fullerton Steel & Wire Co. and uses Dynapar Corp. control equipment.

**Transistorized digital controllers accurately count pulses from sensing devices at speeds up to 75,000 counts per second, actuate various functions of other equipment when a preset number is reached, and instantaneously reset to zero with no loss of count. The author discusses the application of this equipment in controlling both simple and complex industrial processes.**

this kind of counting-control equipment. Since measurement can be an integral element of many control processes, digital electronic counting-control methods provide a means for meeting stringent requirements of high accuracy at high operational speeds.

In addition to their major advantages of speed, high resolution, and accuracy, digital electronic counting-controls provide many other useful benefits. These include extreme flexibility, reliability (especially when transistorized solid state circuits are used), remote operation, fast setup and changeover, easy-to-read numerical indication, printed readout if required, and minimum supervision—usually with nontechnical personnel.

Fig. 2—Zero-speed rotary pulse generator has an internal pulse disk which can be built to provide from one to 1200 counts per revolution. As the disk rotates in the unit, a light beam is interrupted by the perforations in the disk so that a photoelectric cell is constantly being energized and de-energized to create pulses. This unit has a built-in transistor trigger circuit and power supply. Mounted on the shaft of the generator is a measuring wheel which converts linear motion to rotary motion.

## ▸ Digital Methods

The digital method expresses counts or measurements in the form of discrete electrical pulses which can be counted, stored in a memory unit, and transmitted over any distance without error or drift. The pulses can be manipulated to provide numerical readout of a measurement and actuation of automatic control functions at any predetermined number or series of numbers within the cycle of operation. Whatever the quantity (linear or nonlinear) to be counted or measured for control purposes, the digital technique consists of breaking the measurement into incremental parts which are always much smaller than the required accuracy.

For example, in a linear measurement-control application, a digital rotary sensing device can convert mechanical motion, material travel, position, etc., into a series of electrical pulses—each pulse representing a fractional unit or degree of measurement, *Fig.* 1. This output information is in a stable digital form and can be fed to control equipment and manipulated without loss of accuracy.

The same technique can be applied to measuring the rpm of geared rolls—the control function being automatic speed correction. The rotating roll shaft can be measured as one count (pulse) per revolution, 10 counts, 100 counts, or up to 2400 counts per revolution with standard digital sensing devices.

Two basic methods of digital electronic counting are used. These are: 1. Directly in decimal such as with a cold cathode gas counter tube and the hot cathode beam switching tube. 2. By conversion from binary counting to decimal in the so-called decimal counting units.

In every application, the digital sensing device converts an input (the measured quantity) into a digital pulse output which can be fed to a remote preset controller for counting, numerical readout, or actuation of automatic control functions at any predetermined count. The operator merely adjusts presetting knobs to the desired numerical value where the automatic control function is to take place. After the measurement is converted to digital form, variables such as temperature and humidity cannot affect accuracy. Another advantage is that there is no such thing as drift in a digital system.

## ▸ Basic Operating Functions

Perhaps the simplest way to outline the basic operating principles of high speed digital electronic counting-control systems is to break them down

## COUNTING FOR HIGH SPEED CONTROL

into three distinct operating functions—sensing, indicating, and controlling.

**Sensing Functions.** A wide range of digital sensing devices are used to convert an input (the measurement) into a digital pulse output which can be counted and manipulated to meet specific control requirements. Linear measurements can be converted into accurate pulse information by means of a zero-speed rotary pulse generator, *Fig.* 2. A standard measuring wheel is connected to the generator shaft to convert all kinds of mechanical motion or position into corresponding revolutions. Each revolution of the generator shaft generates an exact number of pulses. Thus, a sensing unit which generates 1200 counts per revolution produces one count or pulse for each 0.01 inch of material travel when a measuring wheel with a 12-inch circumference is used. For direct rotational measurement-control applications, the shaft of the rotary pulse generator can be connected directly to the shaft of the unit to be measured—conveyor, rolls, motor, etc.—to provide the necessary counts per revolution.

Other types of sensing devices can also provide the desired units of measurement. A photoelectric pickup can count the revolutions of a slotted drive wheel or can count small parts, irregular shapes, gear teeth, etc. Magnetic or proximity pickups can detect and count all types of metallic objects without direct contact. Direct-coupled electrical inputs, contactor inputs, and various digital transducers can be used, depending upon the limitations and requirements of each installation.

**Indicating Functions.** Direct - reading numerical indication of measurement is necessary in many applications to enable operators to supervise production, keep records, or perform manual functions at specific counts. The pulses fed from sensing devices can be continuously displayed as counts on a preset controller panel, *Fig.* 3, by either illuminated numerical indicator tubes or by glow counter tubes. Readability is good up to 50 feet. If desired, numerical readout can be remote from both the counting source and the control equipment.

A channel switch is often incorporated in the panel to display counts at will of two or more inputs. Printed readout, with symbols, dates, totals, etc., can also be incorporated to provide permanent records of everything that takes place. The display is provided with the desired number of digits, and the readout is shown as any desired unit of measurement—inches, fractional inches, feet, rpm, gallons, pounds, etc.

**Control Functions.** Pulses from the sensing devices are counted or accumulated by the preset controller. When a preset number set up on the panel is reached, the controller closes a fast-acting mercury relay. This automatically triggers the controlled mechanism. This can be a power shear, positioning device, hopper or bin gate, feed chute, reel-changing device, machine tool, packaging machine, or other equipment. Multiple control functions can be performed at successive preset numbers. This technique is often used when controlling high speed machines which must be slowed-down in stages before the automatic control function is actuated.

After actuation, the controller automatically resets for the next operation. Maximum operating speeds are usually limited only by the capacity of the equipment being controlled.

### Control Equipment

Electronic controllers, using true digital logic *AND* and *OR* gates, have the capacity to accumulate closely-spaced electrical pulses in an extremely short sampling time, with no time delay between input and output. For example, a shaft may rotate at 2000 rpm. If the digital sensing unit generates 1200 pulses per revolution, the electronic preset controller must have a counting capability of at least 2.4 million counts per minute.

In comparison, mechanical registers are usually limited to operation below 600 counts per minute for such jobs as totalizing part counts, measuring length, or determining speed. Flag-operated power shears are limited to speeds of 150 feet per minute and are impractical for cutting either extremely long or short lengths. Mechanical preset counters can be awkward to reset when used in continuous process applications. Accurate ratio counting is usually difficult and time-consuming when accomplished by mechanical means, and programming of events is impractical. These jobs can be performed at high speed and with high accuracy by electronic counting-control methods.

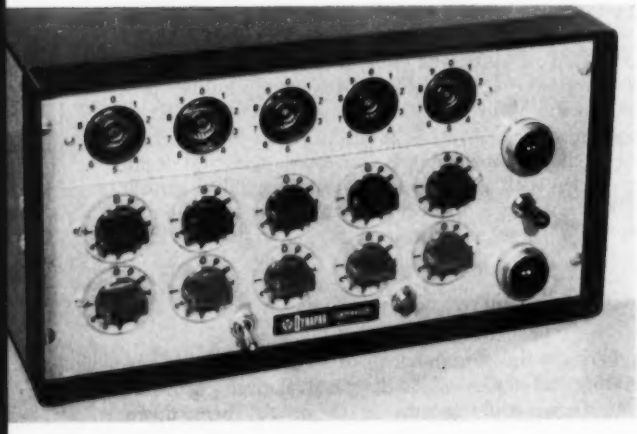


Fig. 3—Electronic preset controller accurately counts pulses from all types of sensing devices and is used to control other equipment when a preset number is reached. This unit can provide from one to 180,000 counts per minute with instantaneous reset to zero with no loss of count. Two rows of setting knobs are provided so that a second batch number can be installed in the panel while the first batch number is being counted.

**TABLE 1—Typical Applications of Electronic Counting-Control Equipment**

| Types of Measurement-Control | Applications | Typical Industrial Equipment | Digital Sensing Devices | Digital Control Equipment |
|---|---|---|---|---|
| Linear Control | Cutting-to-length | Power shears | Rotary pulse sensors | Preset controllers |
| | Materials flow control (textiles, sheet metal, paper) | Conveyors, rolls | Rotary pulse sensors | Preset controllers |
| | Wire footage & fault control | Spool/reel machinery | Magnetic pickup | Footage-fault controllers |
| Rotational Control | Motor speed control | Conveyors, motorized equipment | Rotary pulse sensors | Speed controllers, proportional controls |
| | Motor slip measurements | Motors | Rotary pulse sensors | Motor slip indicators |
| | Belt speed measurements | Conveyors, rolls | Rotary pulse sensors | Tachometers |
| Ratio Control | Paper draw control | Paper mill rolls | Rotary pulse sensors | Speed & draw indicators |
| | Metal elongation control | Steel mill rolls | Rotary pulse sensors | Elongation indicators |
| Positioning Control | Material positioning | Gage blocks, runout tables | Bi-directional sensing units | Add-subtract preset controllers |
| | Machine tool positioning | Welders, drills | Bi-directional sensing units | Add-subtract preset controllers |
| Unit Control | Parts counting/control | Packaging, feeding eqpt. | Photoelectric or magnetic pickups | Preset controllers |
| | Sorting, classifying | Feeding devices | Photoelectric or magnetic pickups | Preset controllers |
| | Coil winding | Coil winding machinery | Photoelectric or magnetic pickups | Preset controllers |
| | Packaging control | Wrapping, packaging eqpt. | Photoelectric or magnetic pickups | Preset controllers |
| Inspection or Tolerance Control | Over-height control | Materials handling | Photoelectric or magnetic pickups | Preset controllers |
| | Over/under length control | Materials handling | Photoelectric or magnetic pickups | Preset controllers |
| | Side register control | Materials handling | Photoelectric or magnetic pickups | Preset controllers |
| | Stacking control | Materials handling | Photoelectric or magnetic pickups | Preset controllers |
| | Web break detection | Materials handling | Photoelectric or magnetic pickups | Preset controllers |
| Volume & Weight Control | Hopper/bin level control | Process systems | Rotary flow meters | Preset controllers |
| | Batching/formula blending | Process systems | Rotary pulse sensors or flow meters | Programmed controllers |
| | Fuel flow control | Process systems | Rotary pulse sensors or flow meters | Preset controllers |
| | Pressure-thrust control | Heating systems | Pressure transducers | Preset controllers |

Transistorized electronic equipment has many advantages. These include low power consumption, no warm-up time needed, little heat given off, unaffected by vibration, and long service life since there are no moving parts to wear out. Plug-in circuit construction also simplifies maintenance. Recent developments permit reliable operation at temperatures up to 150F.

Although preset counters must often be engineered for specific applications, great progress has been made in "packaging" standard plug-in modules and assemblies to meet various industrial requirements and still maintain ruggedness and sealed enclosures suitable for average factory conditions. Such units can be manufactured in various arrangements of modules having plug-in circuits, stockpiled, and then packaged for specific applications.

## ▶ Applications

TABLE 1 shows the range of applications along with typical digital sensing devices and controllers used. In general, virtually any mechanical motion which can be converted into digital voltage pulses by sensing devices can be accurately measured. Electronic preset controllers can accurately count in excess of 75,000 units per second. This includes such diverse objects as bottlecaps, ball bearings, books, candy bars, screws, and virtually anything that moves.

An ever present problem is the development of faster and more flexible digital sensing devices. Typical sensing units are now available which can be used with preset controllers for many high speed

## COUNTING FOR HIGH SPEED CONTROL

applications. An example is filling cartons with exactly the right number of small parts. At a predetermined count, the preset controller can automatically actuate a diverter gate and reset to zero before the next count enters to start a second batch. This program can be set up for continuous operation, or, for short runs, the system may be changed manually by operating preset knobs for each batch.

Sometimes special modifications are incorporated into a system to overcome inherent difficulties. For example, in continuous batch-type, cutting to length operations, it is possible to use two rows of length presetting knobs on the controller panel. While one batch is in progress, the operator can set up the next batch with the second series of knobs. When a new batch of a different length is to be started, the operator can actuate the switch to energize the second counting system.

Another modification which may be necessary when material speeds vary is a speed compensator control. For example, when material is being cut to length in a shear, there is a fixed time delay between the moment the controller relay is tripped, energizing the shear mechanism, and the moment the shear actually cuts the material. This time interval may be as small as 0.02 second, or it may be considerably greater. If the material is moving under the shear blade at a speed of 150 feet per minute, and if the fixed time delay is 0.10 second, an error in cutting length of nearly 0.72 inch could result with only a 20 per cent change in material speed. When a speed compensator control is used, the control automatically adjusts the time at which relay closure is initiated, as material speed increases or decreases, so that the material is sheared at the precise moment necessary to attain the desired cutoff length.

In more sophisticated continuous process or sequencing applications, digital control systems can measure a desired quantity, actuate various automatic control functions, simultaneously check the number of faults in each piece or unit of measurement, shut down the system if faults exceed a specified maximum, and warn the operator. At the same time, the system can be continuously recording the events or results on paper tape.

Most preset controllers and sensing units are flexible enough to be integrated into existing production or process systems when modernization or replacement is necessary. The controllers often can be installed remotely in centralized control panels. In many cases, they are installed directly in industrial machines as original equipment.

### When To Use

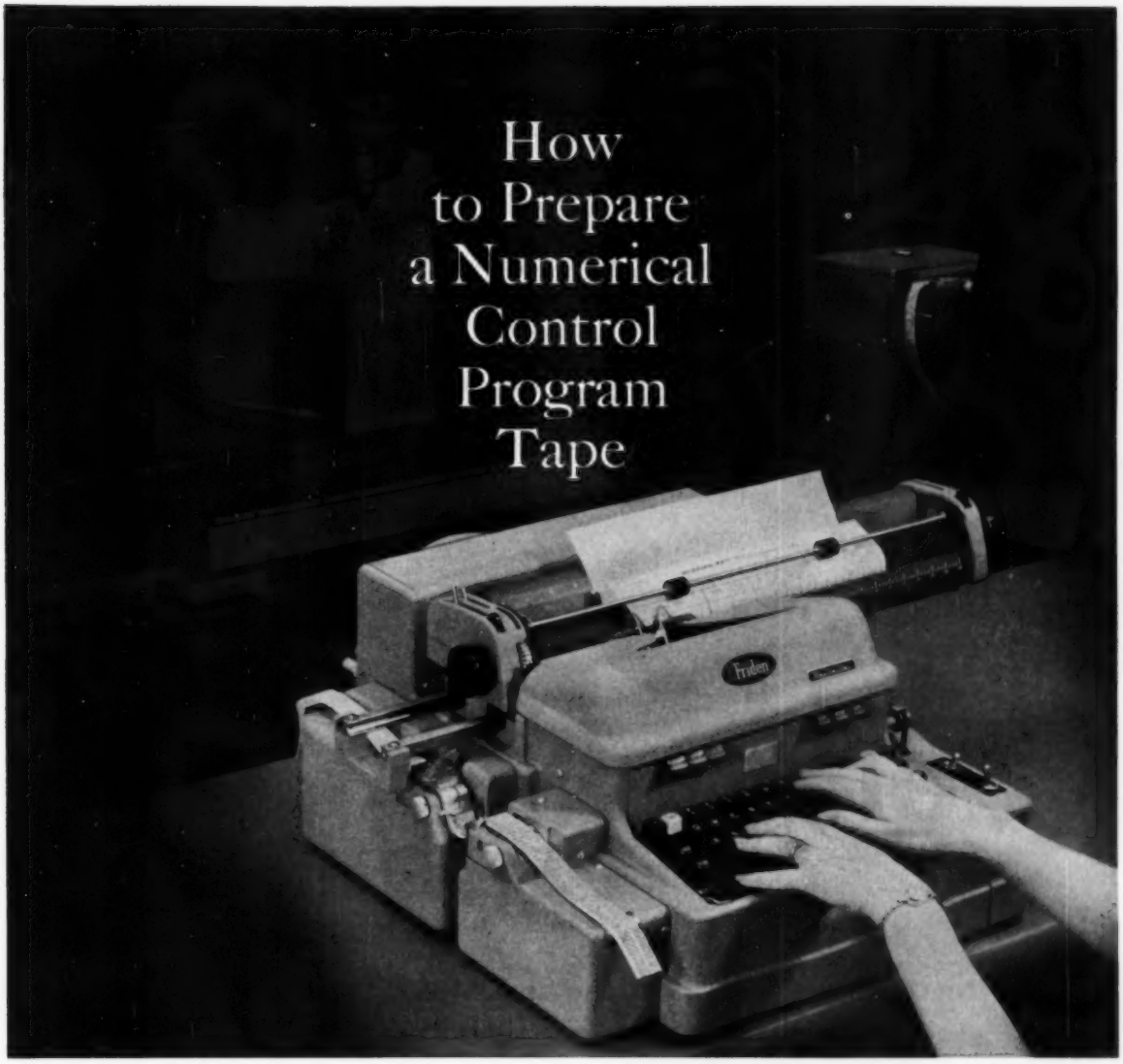
The following data should be evaluated in terms of specific industrial applications to determine whether high speed digital electronic counting-control is likely to improve productivity and reduce operating costs. In each of the following conditions, the digital method is capable of meeting the specifications outlined. Consideration should be given to this method if any one or more factors outlined are present in a prospective application.

1. Over-all process accuracy must be maintained within one per cent or better.
2. Close tolerances must be maintained to variable accuracy requirements.
3. Highly accurate measurements are required within an extremely short sampling time.
4. Measurement is such that cumulative errors are likely to be large with analog and other control methods.
5. Data must be linearized or processed (added to, subtracted from, multiplied by, etc.), and accuracy must be maintained within one per cent or better.
6. Long term stability is important without zeroing, calibrating, or readjusting equipment.
7. Measurements must be transmitted over a distance with accuracy, or to multiple locations.
8. Measurements must be recorded numerically, or with identification symbols, dates, channels, etc.
9. Information must be stored, perhaps with provision for rapid access.
10. Data must be interpreted by nontechnical personnel.
11. Environmental conditions such as temperature, dirt, etc., can cause unreliable operation with other methods.
12. Removal of personnel from installation will permit increased operating speeds.

Economic justification for an electronic digital counting-control system is of course an individual problem. However, in determining whether to adapt this type of control to production, costs of electronic equipment should be compared with projected savings resulting from increased efficiency, accuracy, faster production rates, consistent product quality, elimination of downtime, and less work or personnel required.

## can we help?

It has been pointedly mentioned at various times that in engineering automated systems new as well as old techniques and devices may prove extremely useful. Practical results require the investigation of all available equipment that can contribute to the effective development of suitable automatic lines. Information on such equipment is presented in various departments of the magazine each month as useful data become available. To aid in obtaining detailed data for further evaluation a post card is included on page 19. Take advantage of this service. The Editors will be glad to help in this or any other way.

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1) The keyboard is standard; any competent typist can master the other controls in less than an hour.
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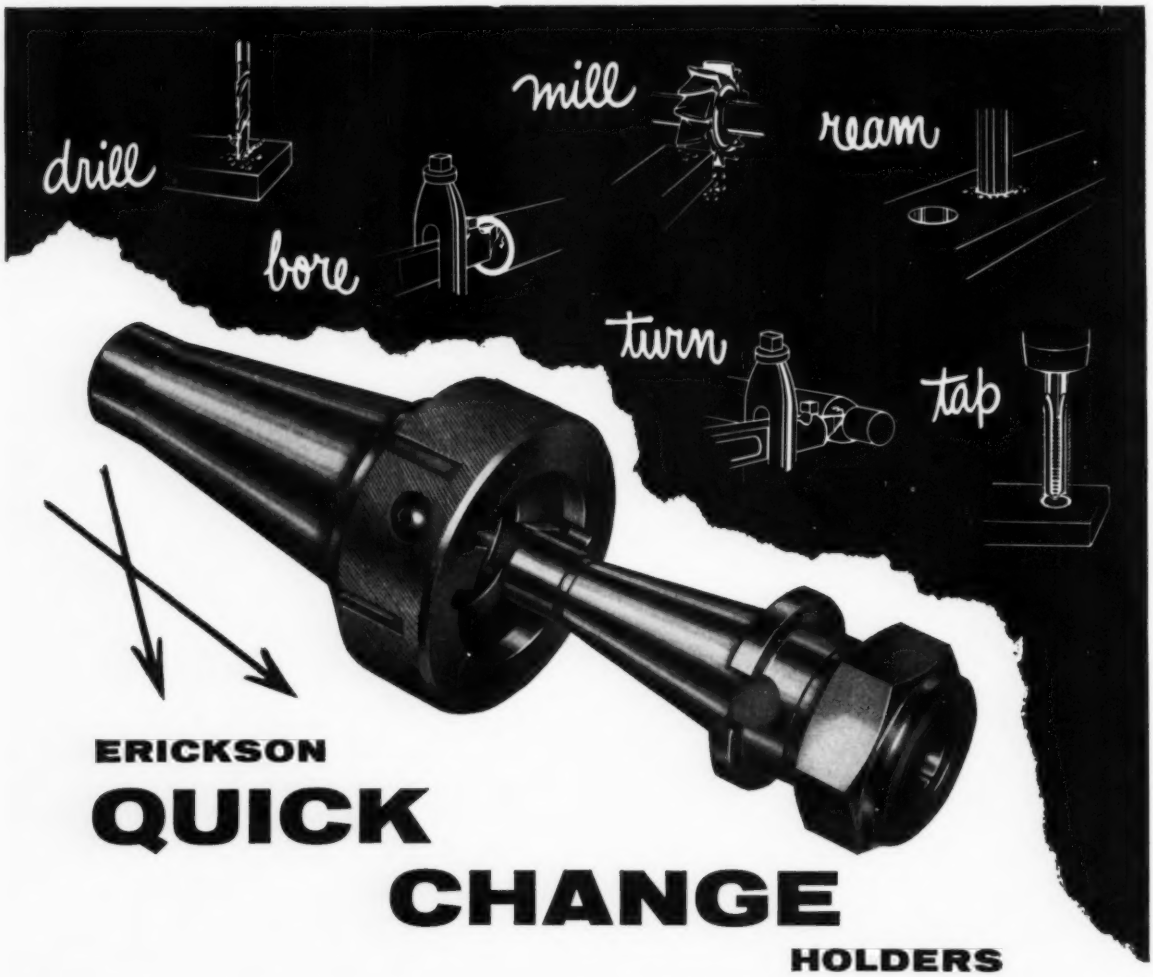


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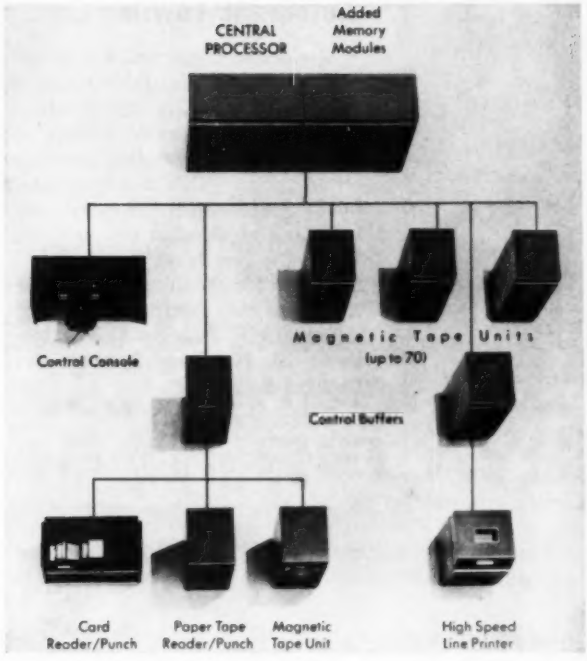
*Circle 693 on Page 19*

AUTOMATION

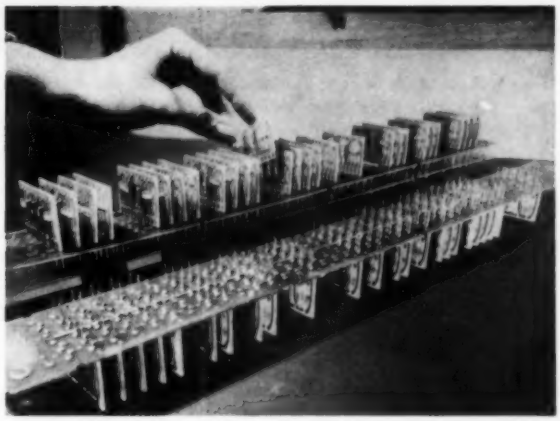
# new equipment

**Machines and plant equipment for more automatic operations.**
**For detailed information and literature, use card on page 19.**




Data-processing system consists of a central processor, control buffers, and matched input-output units including magnetic tape, high-speed printer, punched tape, and punched card equipment. The processor has a core memory of 4096 words which can be expanded to a maximum of 32,768 words with the addition of memory modules.

All-electronic computing system has 180 cribbage board type panels, consisting of 5000 transitors and 30,000 diodes.



## Multiple Input/Output Data System

ELECTRONIC data-processing system is capable of 45,000 floating point operations per second. The system, designed by **Bendix Aviation Corp.**, 5630 Arbor Vitae St., Los Angeles 45, Calif., consists of a high-speed central processor, control buffers, and matched input-output units including magnetic tape, high-speed printer, punched tape, and punched card equipment. Both algebraic and symbolic programming systems are provided. Feature of the Model G-20 system is the control buffer units. The control buffer is a stored program computer-like unit employing a 1024-character magnetic core memory. The memory is used as a store for commands as well as a buffer for input-output data. It connects to two communication lines; the computer line and a buffer line. In operation, it communicates with the computer or magnetic tape equipment at high speed on the computer line and then operates the slower input-output equipment on its buffer line. The buffer can receive and transmit blocks of information and translate character codes at high speed. It transmits interrupt signals which can be used to interlock a multi-element system in the performance of complex operations.

The processor is a general purpose computer with magnetic core storage and parallel arithmetic. It contains about 5000 transistors and 30,000 diodes in addition to either one or two modules of core memory containing 4096 words each. Internally all arithmetic is performed in integer floating-point form. Each number is represented by a positive or negative integer (equivalent to 12 decimal digits) and a multiplier which is a power of ten. The exponent of the multiplier may range from $-56$ to $+56$. Numbers can be automatically stored from the arithmetic unit in any of three forms: Single-precision floating point in which a six-decimal digit integer and its exponent is stored in a single

memory location; extended precision floating point, in which a 12 decimal digit integer and its exponent is stored in two consecutive memory locations; and fixed point in which an eight-decimal digit fixed point number is stored in a single memory location. The line of input-output equipment available for the system includes magnetic tape units that read and write at 120,000 digits per second and 600 to 1250 line-per-minute printers.

*Circle 401 on Page 19*

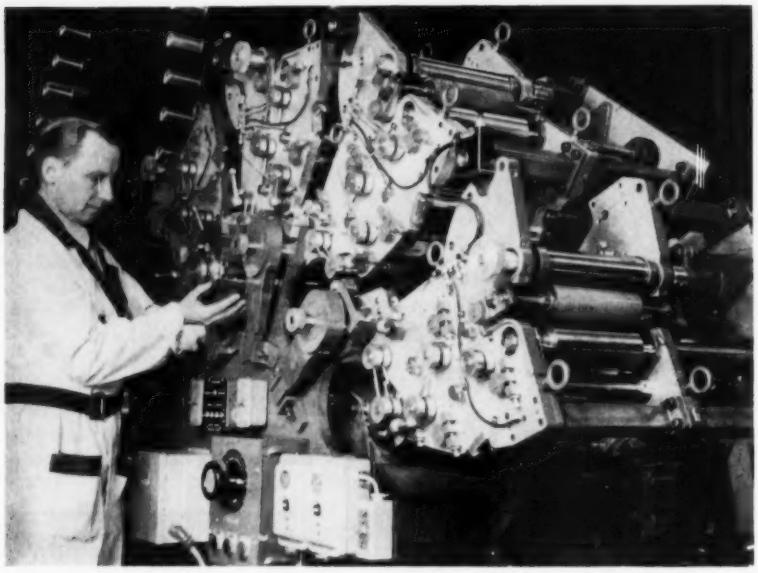


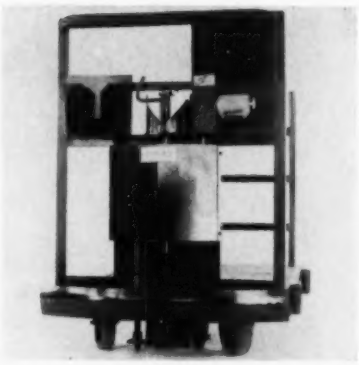
Illustration shows the arrangement of the four color stations of the cylindrical can printing machine. Each color station is a self-contained unit including impression roller, plate, and ink fountain. Interchangeability and independent make-ready off the machine speed changeovers.

## Cylindrical Can Coaters and Printers

Line of coating machines and printing machines is designed for cylindrical cans; the type used for beer and fruit juices. Illustration shows a printing machine. The units can be used in tandem if wanted. Synchronized conveyors running through the drying equipment and on to the printer dovetail with one another. Either machine can also be used without the other. In operation, topless units astride rods or spindles move through the coating machine where they acquire the background color. From there they move on to the printing machines, where printing and illustrations, in as many as five colors, are applied in a single continuous, rotational operation.

Both machines feature an automatic feed mechanism, arranged so that cans can be removed from conveyor chains and placed on spindles, for either coating or printing. Another feature is a can-carrying turret that has a related feed mechanism which is automatically moved out of contact with printing and coating rollers whenever a can is missing from the spindle about to reach the printing stage. The entire turret moves out of reach of the printing ink and then returns to position automatically. If a series of empty spindles come up at the printing position, the turret moves away and stays out of contact until reset. A companion to the printing machine is a portable preregister device. It is used for positioning plates on a workbench where plates are made ready and color stations are set up with the aid of optical lenses and prisms, and cross-hair sighting. **Rutherford Machinery Co., Div., Sun Chemical Corp.**, 401 Central Ave., East Rutherford, N. J.

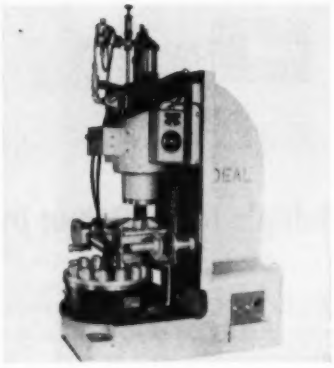
*Circle 402 on Page 19*



## Automatic Towline Cart

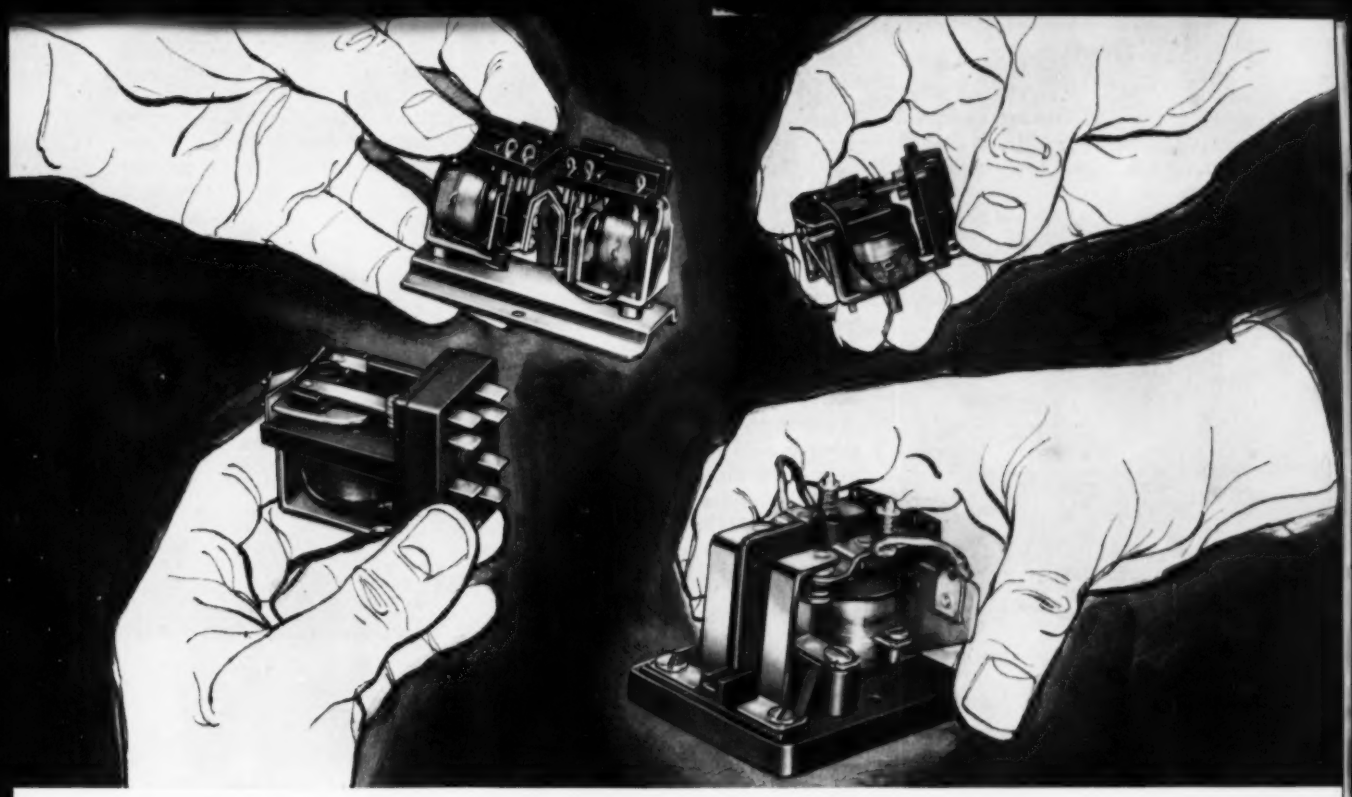
Mechanically-controlled system is designed for automatic switching of towline carts. The design allows carts to automatically switch off towlines and accumulate at preselected points. This is accomplished by a mechanical memory and switching mechanism on each cart. When the cart is on the towline, a dial is set for the destination. When it reaches that destination, the cart automatically switches off the towline. **SI Handling Systems Inc.**, Phillipsburg, N. J.

*Circle 403 on Page 19*



## Hot Stamping Press

Hot stamping press uses foil tape to print in any color or mark on a variety of surfaces and materials such as plastics, leather, paper, wood, and composition materials. Unit is adaptable to fit any standard punch press. It is pneumatically controlled, but hydraulic control is optional. Features of the press include: Electronic dwell control; precision thermostatic control; adjustable, automatic foil feed; and



# save time! save money! call your parts distributor for P&B RELAYS

These important savings are yours when you order—from your Electronic Parts Distributor—P&B relays listed with Underwriters' Laboratories, Inc. and Canadian Standards Association:

**SAVE TIME.** You get fast, off-the-shelf delivery. Usually your order is shipped the day after it is received. And no waiting for U/L or CSA clearance . . . this has been done for you. Thus you get your project—and your product—off to a fast start!

**SAVE MONEY.** You save the cost of getting relays listed with U/L or CSA . . . and you need have no big investment in shelf inventory, either. Remember, you pay no premium over factory prices in quantities to 249.

More than 40 different standard P&B relays in 450 different coil voltages and contact arrangements are available from the leading Electronic Part Distributors in your area. For special applications, call your nearest P&B sales engineer.

**PR Series**

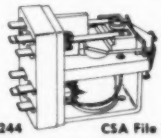
| Type | Contact Arrangement* | Type | Contact Arrangement* |
|---|---|---|---|
| PR1AY | SPST-NO | PR5AY | SPDT |
| PR3AY | SPDT-NO-DM | PR7AY | DPST-NO |
| | | PR11AY | DPDT |

These relays are available in any of the following operating voltages: 6, 12, 24, 115, 230 volts 50/60 cycles AC.

Contacts are rated at: 25 amps, 115/230 V. AC 1 phase. 1 hp for 115/230 volt AC motors 1 phase.

*Read: NO normally open, NC normally closed, DB double break, DM double make.

U/L File E22575 CSA File 15734



**AB Series**

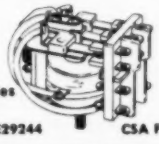
U/L File E29244 CSA File 15734

For appliance and general purpose operations requiring long life and quiet operation. Quick connect terminals. Screw terminal adapters also furnished with each relay. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.

**ABC Series**

U/L File E29244 CSA File 15734

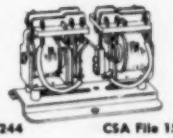
Medium duty power relay in dust cover. For small motors, industrial controls and similar applications. Contact arrangement: DPDT. Rated at 10 amps, 115 V., 5 amps, 230 AC non-inductive by U/L and CSA.



**KA Series**

U/L File E29244 CSA File 15734

Small, low cost, general purpose relay for handling automation work, small motors, solenoids, other relays. Contact arrangements: SPDT, DPDT and 3PDT. Rated at 5 amps, at 115 V., AC non-inductive by U/L and CSA.



**KB Series**

U/L File E29244 CSA File 15734

Compact latch relay ideal for memory work and overload applications. Operates on momentary impulse to either coil. Contact arrangements: 4PDT and 6PDT. Rated at 5 amps at 115 V., AC non-inductive by U/L and CSA.

**POTTER & BRUMFIELD**

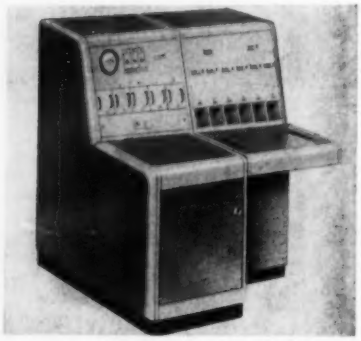
DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

*Circle 694 on Page 19*

positive stroke adjustment and pressure up to 4800 lb. **Ideal Stencil Machine Co.**, Iowa Ave., Belleville, Ill.

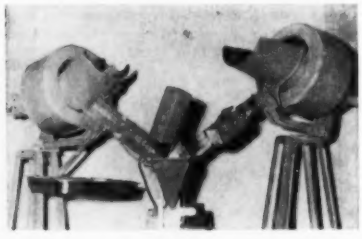
*Circle 404 on Page 19*



## Transistor Tester

Semiautomatic transistor tester measures significant parameters and compares the results of such measurements against various specifications for the individual types of transistors. All measurements in the sequence of tests are performed while the transistor is in a single test position. The transistors are then sorted in a chosen order of priority, depending on their response, for audio, rf, or switching applications. Rate of transistor testing is in the order of 30 or 60 tests per second, within an accuracy of 0.5 per cent. Unit can be used to test other types of electronic components such as resistors, capacitors, diodes, and tubes. **Monitor Systems Inc.**, Fort Washington Industrial Park, Fort Washington, Pa.

*Circle 405 on Page 19*



## Packaging Machine

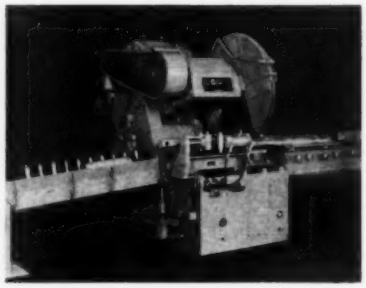
Semiautomatic machine is capable of packaging items such as nuts, bolts, screws, buttons, pills, and capsules. Feature of the unit is a bag device which is used in conjunction with the feeders. In the illustration, the machine is feeding belt buckles and eyelets to a bag. Either paper or plastic bags can be used. The leading bag is held open by a small blower built into the system. As one bag is removed by the operator, or drops away due to the load deposited by the feeders, the next bag automatically comes into position with the top open for deposit of contents. The cycle of the machine is adjustable; it can be made to operate either automatically or cyclically under the control of the operator. **Aidlin Automation Inc.**, 1613 E. New York Ave., Brooklyn 12, N. Y.

*Circle 406 on Page 19*

## Tape Converter

Bidirectional tape unit converts information directly from punched paper tape produced by teletype transceivers to magnetic tape in any parallel 7-bit alphanumeric code. Paper tape data are introduced into Model D104 by a photoelectric reader operating at 300 characters per second. The magnetic tape is read or prepared in a form compatible with the computer it is to feed. The converter can also be made to recognize the distinction between legitimate data and items in nonstandard format (such as correction messages explaining errors in previously transmitted records and sign off messages after completion of record transmission). Distinctions between types of records can also be made. Paper tape output is prepared by a high-speed perforator punching at a rate of 2400 wpm in standard teletype five-level code. The input and output data are in different codes but they are identical in content except for certain editing and format control characters appearing on the output tape. **Dykor Systems Div., Digitronics Corp.**, Albertson Ave., Albertson, L. I., N. Y.

*Circle 407 on Page 19*

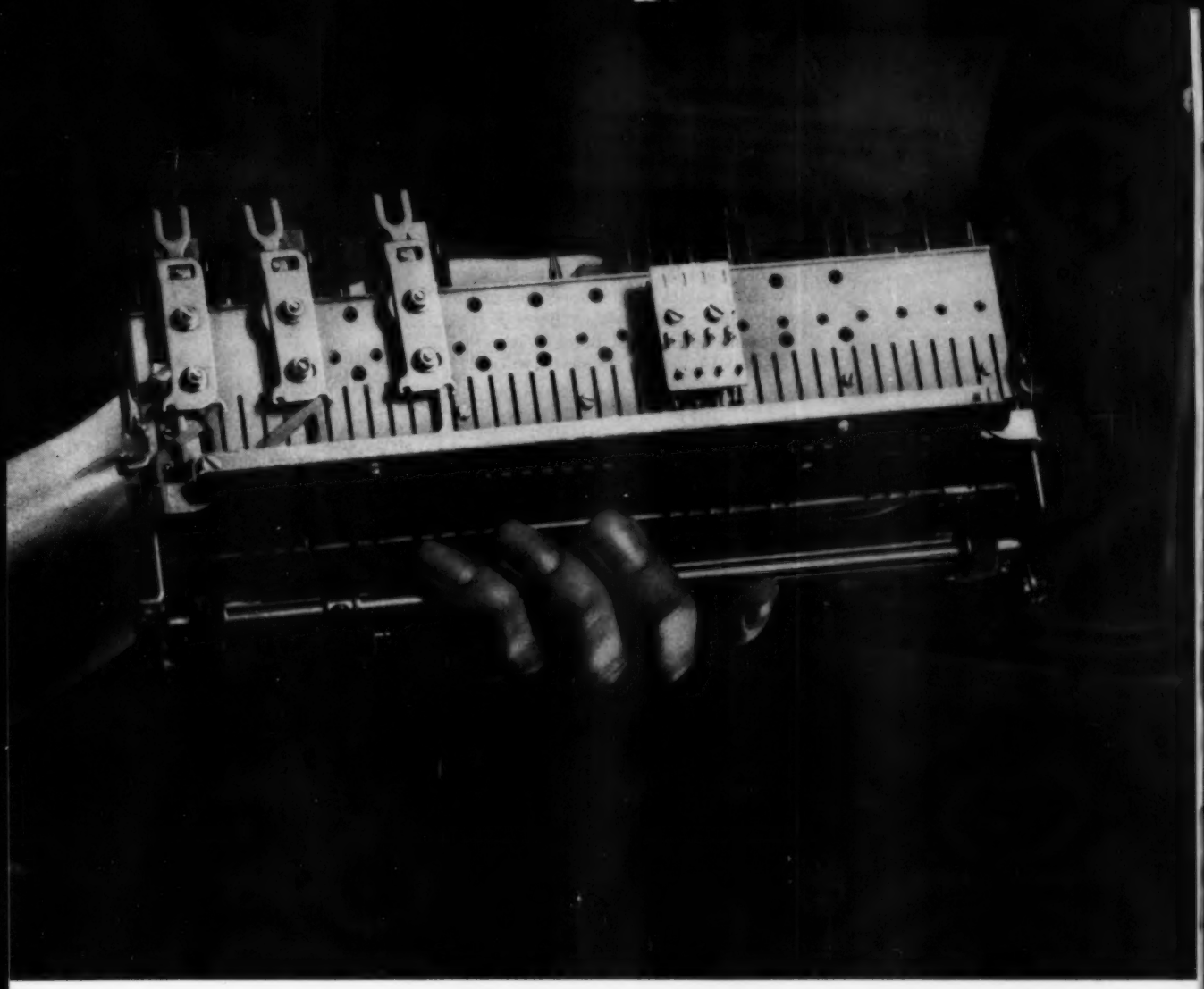


## Billet Saw

Machine, equipped with a 48-inch diameter sawblade driven by a 75 hp motor at speeds between 4000 and 8000 fpm, can cut aluminum alloy billets up to 16 inches in diameter. Feature of the saw is a tilt arm which effects a downward movement of the sawblade. This arrangement results in the feed pressure being taken by the housing, eliminating any chatter during the cut. The feed speed is steplessly adjustable, and the automatic return of the tilt arm occurs at high speed, holding idle time to a minimum. The sawblade rotates in such a direction that chips and coolant are carried away from the operator and are disposed of through an automatic chip conveyor.

In operation, when the escapement pushbutton is actuated, the billet leaves the storage table and is entered into the saw by the feed conveyor. The length stop is in position ready to halt the advancing billet. The hydraulic clamp of the machine grips the billet, the stop swings out of the way, and the saw cut is made. The cut billet travels down the discharge conveyor and is removed to the storage rack. Upon return of the saw tilt arm, the clamp has been released, the length stop has swung into position, and the billet is advanced by the feed conveyor for the next cut. **Loma Machine Mfg. Co. Inc.**, 114 E. 32nd St., New York 16, N. Y.

*Circle 408 on Page 19*



# *Stunt Box—your Big Plus with Teletype printers*

Built into Teletype Model 28 page printers is a control device called the Stunt Box. The function of this unique component is to provide extra control facilities for both local and remote operations. Thus—in addition to transmitting, receiving and recording messages and data—the page printer can be used for a variety of switching, remote control and selective calling tasks.

The Stunt Box reduces costs by simplifying equipment needs and systems arrangements. It is the Big Plus—the extra value in Teletype Model 28 page printers and automatic send-receive sets.

Teletype Corporation manufactures this equipment for the Bell System and others who require the finest in data communications equipment.

Write for free 20-page brochure, "The Teletype 28 Stunt Box," to Teletype Corporation, Dept. 25F, 4100 Fullerton Avenue, Chicago 39, Ill.

Typing Tape Punch

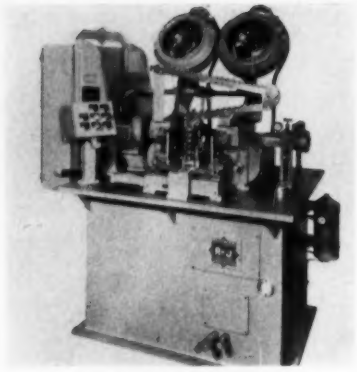
Tape Reader

Send-Receive Page Printer

Automatic Send-Receive Set

**TELETYPE®**
**CORPORATION**
SUBSIDIARY OF *Western Electric Company* INC.

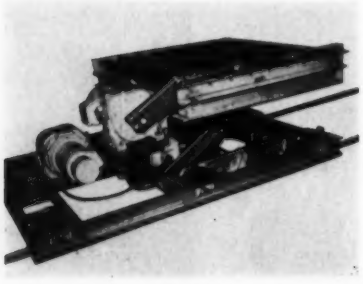
Circle 695 on Page 19



## Needle Bearing Assembler

Equipment automatically feeds and greases the inside diameter of automotive transmission gears, and automatically loads needle rollers into gear. Production rate is 2200 completed assemblies per hour. Feature of the machine is a hydraulically operated reciprocating slide which permits the loading of a gear at each index of the slide. The slide is arranged with two fixtures. As one assembly is being ejected and the new gear is being loaded, needles are being assembled into another gear in the second fixture. The machine can be adapted to other types of gears and bearings requiring the assembly of needle rollers. **Rehnberg-Jacobson Mfg. Co.**, Rockford, Ill.

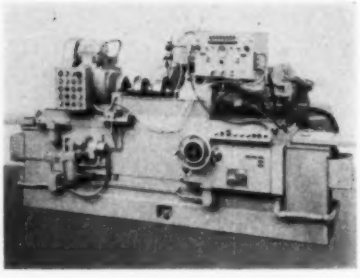
*Circle 409 on Page 19*



## Traveling Lift Table

Hydraulic lift table with transfer car is applicable for moving work from one station to another. In the illustration, a scissors-type lift table is mounted to travel on an inverted angle track. The table is used for either loading or unloading sheets on pallets at the start and completion of a process. There are three 1 hp motors on the table, one each for elevating loads, powering the roller conveyor, and for propelling the car along the track at 25 fpm. The rollers also move loads off and on the table at 25 fpm. Throwing a lever causes skate wheels to move up between the rollers so empty pallets can be moved off and on at right angles to the movement of the loaded pallets. **West Bend Equipment Corp.**, West Bend, Wis.

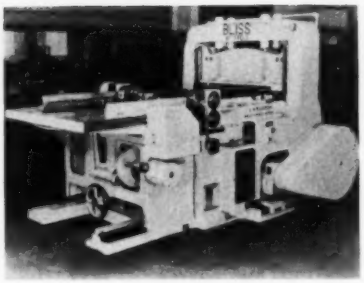
*Circle 410 on Page 19*



## Angular-Slide Grinder

Semiautomatic angular wheel slide grinding machine is designed to combine OD and shoulder grinding in a single, fast, automatic cycle. Sizing adjustments as fine as 0.00005 inch on work diameter are possible. Built to feed at either 30 or 45 degrees, the machine is applicable on crankshafts, steering knuckles, gear blanks with hubs, and stepped shafts with critical flanges, tapers, and shoulders. Feature of the machine is automatic behind - the - wheel profile truing which has provisions for two to ten passes with or without diamond advance on the last pass. It can be set to true after a predetermined number of pieces have been ground. Other features are automatic grinding wheel balancing and an automatic infeed cycle. When the grinder is set for automatic operation, pressing the wheelhead advance button initiates an automatic cycle that hydraulically clamps the table, rapidly advances the wheelhead, starts work rotation, grinds at fast feed rate, grinds at slow feed rate, tarries, rapidly returns the wheelhead, stops work rotation, and unclamps the table. **Grinding Machine Div., Cincinnati Milling Machine Co.**, Cincinnati, Ohio.

*Circle 411 on Page 19*




## Scroll Shear

Equipment produces scrolled strips used in the manufacture of can ends, screw caps, and similar closures. The machine, capable of shearing sheets up to 36 inches square, is fitted with trimming cutters that can be ground in place by means of a standard slitter cutter grinder. Access to the cutters is provided by mounting the first table on gibbed ways so it can be slid back from the second table. Cam-actuated side gages on the first table adapt the scroll shear to either lithographed or plain sheets. Magnetic feed bars and hardened back gages insure precise registry of the sheet for each cut. The strips are automatically discharged to the top stacking bin, and scrap from the first cut is collected in the second bin. **Container Machinery Div., E. W. Bliss Co.**, 1375 Raff Rd., S. W., Canton 10, Ohio.

*Circle 412 on Page 19*

## Catalytic Fume Disposal

Integrated system converts noxious fumes, odors, and vapors from a variety of industrial processes to carbon dioxide and water vapor. Unit consists of an insulated sheet-

# ROBO-LIFT

**Probably the most efficient distance between any two points** . . . You can see it at work for leaders in virtually any industry—moving powders, pellets, granules or solids—almost anything that freely flows—quickly, smoothly and undisturbed through vertical, inclined or horizontal planes for any distance. For instance: interlocking stainless steel buckets of a number of sizes are filled by vibratory, belt or gravity feeds from top or underside of in-feed section at any number of stations . . . discharge at a multiple number of locations. Foods, drugs, chemicals . . . auto parts and cereals . . . confections and cake-mixes are handled without risk of separation of ingredients. Batching is simplified. Speed is matched to optimum speed of processing or packaging machines; it stores products in its own buckets, or conveys to assembly points for temporary storage.

Robo-Lift eliminates re-handling; links production to packaging; unifies and automates virtually any operation . . . needs but a fraction of floor space required for less flexible conveyors.

**20 STANDARD MODELS—CAPACITIES:** from 1.0 cfm to 40 cfm; 90 or 70 degree elevating angle; 10, 15, 20, 24 and 30 inch bucket sizes, stainless steel, or mild carbon steel; top and underdumps, height and length to meet any requirement.

**ENGINEERING SERVICES:** Free analysis and custom design for special problems; specifications for special bucket materials, enclosures, drives, feeds and discharge arrangements—at no extra charge.

Send for six page folder telling complete story of Lynch Robo-Lift at General Mills.

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***FOR MACHINES THAT PACKAGE ALMOST EVERYTHING!***

*Manufacturing engineers of automatic processing equipment in glass, packaging, plastic and other industries.*

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**CORPORATION**
Anderson, Indiana

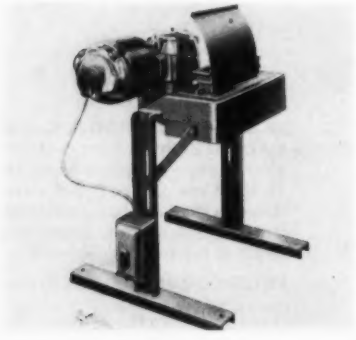


Circle 696 on Page 19

metal housing (containing a preheat burner, catalyst elements, and an exhaust fan) with attached control panel. The catalyst elements destroy organic fumes and odors by changing the molecular structure to inert and inoffensive carbon dioxide and water vapor.

Warm air dilution and heat exchange in the double manifold superheat all fumes and vapors. This eliminates back flow in the system and transfer of combustion hazards from one point in the system to another. The exhaust fan is maintained at constant elevated temperature by the preheat burner. By operating above the temperature of the fume generating process, the fan remains free of residual accumulation, eliminating maintenance chores. The control panel gives visual indication of the heat released by the catalyst, thereby monitoring fume concentration or the rate of delivery from the fume generating process. **Catalytic Combustion Corp.**, 4731 14th St., Detroit 8, Mich.

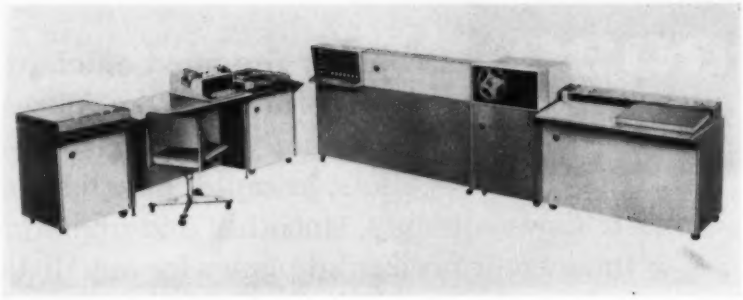
*Circle 413 on Page 19*



## Press Scrap Chopper

Self-contained unit chops skeleton scrap as it comes from a press and stores it for collection. Chopper has a positive cutting action that eliminates all side motion of the cutting blades. Thin hardened material can be chopped without blade spread. Helicoil inserts and backup plates on the cutting blades are features of the unit. Chopper is available in three sizes with capacities in mild steel from 6 by 0.062 inch to 12 by 0.093 inch. **Cooper Weymouth Inc.**, 600 Honeyspot Rd., Stratford, Conn.

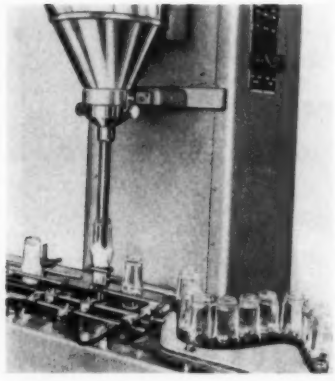
*Circle 414 on Page 19*



## Electronic Data Processing System

System provides automatic in-line records processing. Inputs are accepted in random order and all affected records are automatically updated in a single uninterrupted sequence of operations. Information is entered into the computer from punched paper tape, punched cards, or through the typewriter keyboard. Model RPC-9000 consists of a central processing and control unit (that operates in microseconds, performs the calculations, controls the program, and searches the external memory tape); a continuous magnetic tape file for data storage; and an input-output tape typewriter system that reads paper tape at 60 characters per second and punches tape at 30 characters per second. The internal operating memory includes nine blocks of magneto-strictive delay lines capable of storing 432 instructions or seventy-two 12-character words of data. The external data memory is contained on endless loops of magnetic tape. Each tape loop will store up to 1,000,000 alpha - numerical characters. Optional high-speed input-output units available include a 400 cards-per-minute photoelectric reader for rapid input of data contained in 80-column punched cards; a 500 characters-per-second bidirectional photoelectric paper tape reader; a 300 character-per-second tape perforating unit; and a 150 lines per minute printer. **Royal McBee Corp.**, 700 Westchester Ave., Port Chester, N. Y.

*Circle 415 on Page 19*

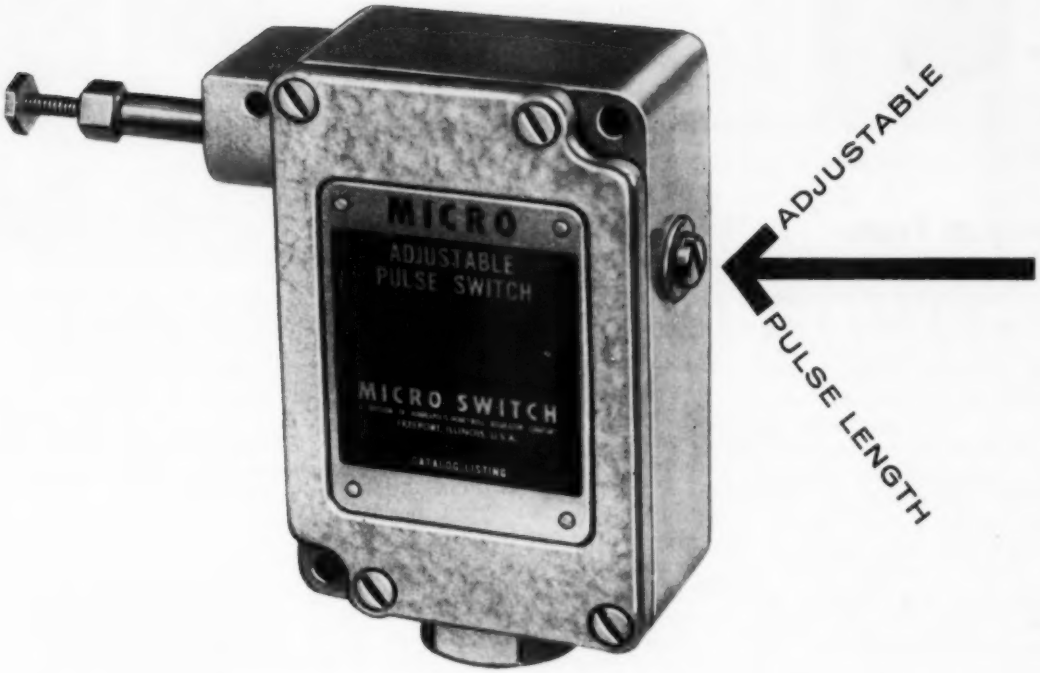


## Universal Filler

Automatic filler can handle a wide range of dry products and almost any rigid container. Feature of Model EG-6 is a serpentine conveyor feed which handles unusual container shapes such as tapered jars (shown). It can also handle cans, cartons, bottles, and boxes. The conveyor feed supports the container in a stabilized position for positive delivery to the filling head. In operation, as the container reaches filling position, it is raised to the filling head by a small platform atop a compressed air activated cylinder. When filled, the container is automatically lowered and carried off by a continuously operating conveyor belt. Three different filling methods are available—adjustable cam volumetric, volumetric packing, and vacuum volumetric. The unit can handle containers ranging in size from 1 by 1 by ½-inch up to 4½ by 4½ by 8 inches. Production rate is up to 50 containers per minute. **Packaging Machinery Div., Food Machinery & Chemical Corp.**, 4900 Summerdale Ave., Philadelphia 24, Pa.

*Circle 416 on Page 19*

MICRO SWITCH Precision Switches




# NEW Single-Pulse Switch

## with adjustable pulse length

A new limit switch has been introduced by MICRO SWITCH for applications where momentary opening and/or closing of a circuit is necessary. It is designed for control of intermittent-duty devices.

The entire pulse operation—actuation and release—is accomplished by depressing the operating plunger. An exclusive feature of the MICRO SWITCH "1PD1" allows adjustment of the pulse from .030" to .450" by simply turning a screw on the outside of the housing. The "1PD1" is sealed against oil, water and dust. Call your MICRO SWITCH Authorized Distributor or the branch office listed in the Yellow Pages. Ask for Data Sheet 173.

**EASY TO WIRE.** By removing the cover plate, the #8 binder head terminal screws are easily accessible for wiring. The "1PD1" has single-pole double-throw contact arrangement, 10 amps.—125, 250 or 480 vac.

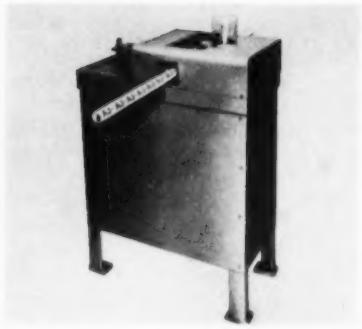
MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
*In Canada: Honeywell Controls Limited, Toronto 17, Ontario*

**Honeywell**
**MICRO SWITCH Precision Switches**

75th YEAR HONEYWELL PIONEERING THE FUTURE



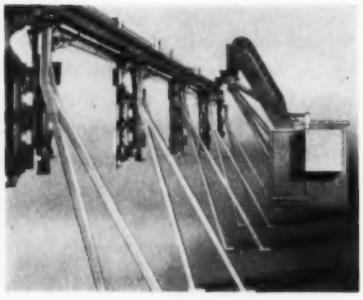

Circle 697 on Page 19



## Continuous Printer

Machine is designed for continuous repeat printing of lettering or design on plastic tubing of various diameters up to 2 inches. It can also be used with rubber and fiber materials. An enclosed ink fountain with a glass cover for visible refill, feeds the liquid ink from a fountain. It has a feed adjustment which provides the right amount of ink for a light or heavy impression. A series of V-rolls, adjustable from a knob on the worktable, adjusts for the tube, rod, pipe, sleeve, or hose diameter, and several different formulas of ink that will flow properly and provide clear printing results. The printing head is driven by a gear reduction motor controlled by a switch on the back. Where a variation of printing speeds for different tubes is needed, a variable speed unit can be included. **Acromark Co.**, 492 Morrell St., Elizabeth, N. J.

*Circle 417 on Page 19*



## Workpiece Distributor

Overhead distribution system is capable of distributing 4200 parts per hour to ten different points. System in the illustration distributes automotive valve bodies equally to ten points, to feed a bank of five chucking machines with two loading stations each. Feature of the arrangement is a cushioned, gravity feed that permits vertical feeding of parts without excessive acceleration. The part rolls rather than falls and reverses its rotation at regular intervals, resulting in a gentle descent that protects it against nicks and scratches.

In operation, valve bodies are elevated from the storage bin to the vibrator orienting table. Then parts are loaded into all empty pockets in the conveyor. The pockets move continuously at a rate of 8 fpm, propelled by a chain-type conveyor. This conveyor also operates notched reloading wheels. At each machine drop, a valve body is transferred into a notched wheel. Each wheel has a single notch into which the body from every tenth pocket is transferred. Wheels rotate and bodies are released to machine loading chutes on demand. When the loading chute is full, the wheel transfers a valve body out of a pocket but retains it until the chute requires additional bodies. **Gear-O-Mation Div., Michigan Tool Co.**, 7173 E. McNichols Rd., Detroit 12, Mich.

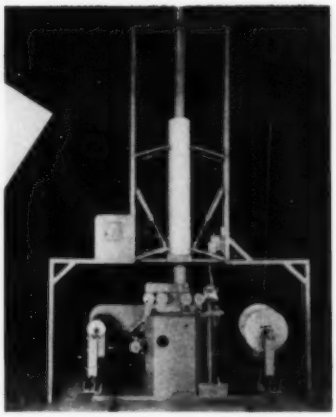
*Circle 418 on Page 19*

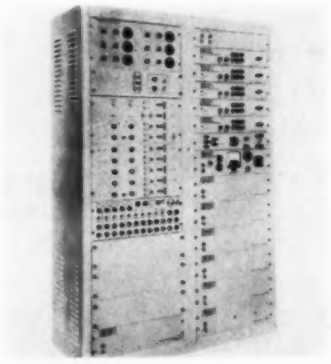
## Wire Striping Machine

Automatic, spiral striping machine can color code nylon and P.V.C. jacketed wire with 1, 2, and 3 stripes at one time on wire from 0.050 to 5/16-inch. Model 1-S stripes at speeds up to 150 fpm. It can handle wire reels up to 30 inches in diameter and is equipped with a variable traverse level winding mechanism which is adjustable for different spool widths. Safety features include a switch which protects against knots and oversize wire and splices and one which protects against broken wires.

Striping machine is equipped with a variable speed motor drive that permits the machine speed to be varied while in operation. A constant tension clutch enables the operator to select the desired speed and tension for different types and sizes of wire. Counting of footage and control of the ink supply is accomplished with a dual-predetermining type counter that can be set to stop the machine at any predetermined footage for re-inking. After the wire is striped, the ink is dried by passing up through a 7 foot vertical drying tower. **Electronic Div., Electronic Production & Development Inc.**, 138 Nevada St., El Segundo, Calif.

*Circle 419 on Page 19*





## Memory Core Tester

Developed for the production-line testing of mass produced magnetic cores, Model 2101 can test cores at the rate of three per second. Feature of the unit is a decision-making logic which can be programmed to accept or reject cores to a variety of specifications. The logic circuit is driven by the output of a comparator circuit which compares six calibrated flat-topped pulses with core amplitude measured by two highly stable linear calibrated sense amplifiers. Amplitude difference between the pulses and the test core is subjected to seven accept-reject decisions based on the predetermined specifications. Cores not meeting specifications are counted

## ERMETO Ease of Assembly Saved These Companies TIME and MONEY

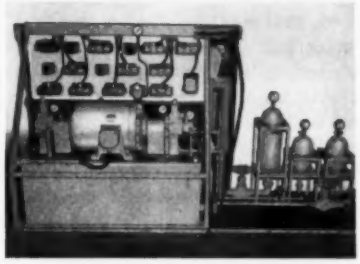
Weatherhead Ermeto flareless hydraulic fittings—easily assembled by inexperienced personnel without elaborate tools—are enabling many companies to achieve important installation savings in both time and money. In service, the excellent leak-proof, anti-vibration characteristics of Ermeto fittings keep maintenance and down-time at a minimum. Ermeto fittings are available in stainless or carbon steel with "Weathercote" or cadmium finish. All shapes in sizes: ⅛ to 2", for pressures up to 10,000 psi.

**SAVED: $5,000**

**COMPANY:** Good Roads Machinery Corporation Minerva, Ohio.

**APPLICATION:** Carbon Steel Ermeto fittings on hydraulically-actuated snow plows on industrial tractors. Operated with hydraulic oil at 100° F and 400 psi.

**RESULTS:** Ermeto fittings saved the company $5,000 because of their ease of assembly and because experienced help was not necessary.



**SAVED: 60 HOURS**

**COMPANY:** Portland Industries South Portland, Maine

**APPLICATION:** Carbon Steel Ermeto fittings on automatic transfer machine for making carburetor bodies. Operated with hydraulic oil at 120° F and 800 psi.

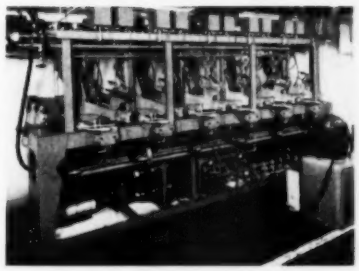
**RESULTS:** Utilization of Ermeto fittings saved the company 60 hours in installation time — thanks to the ease and simplicity of assembly.

**WEATHERHEAD**
**BULK HOSE AND HOSE ASSEMBLIES**

**BULK HOSE**
Twenty different styles available. From ¼" to 2" O.D. for working pressures up to 10,000 psi.

**HOSE ASSEMBLIES**
Completely fabricated with permanently attached swaged ends. Any size, any quantity for working pressures up to 10,000 psi.

Write for new general catalog — contains complete data and specifications for all items.



**SAVED: 40 HOURS or $240**

**COMPANY:** Emhart Manufacturing Company Hartford, Conn.

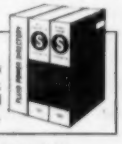
**APPLICATION:** Carbon Steel Ermeto fittings on pressure forming machine for small parts manufacture. Operated with hydraulic oil at 130° F and 1500 psi.

**RESULTS:** Ermeto fittings provided an estimated savings of 40 hours or $240 in installation time. Ermeto fittings were used specifically because of their ease of assembly.

BRASS & STEEL FITTINGS
HOSE & ASSEMBLIES
TOOLS & ACCESSORIES

**WEATHERHEAD**

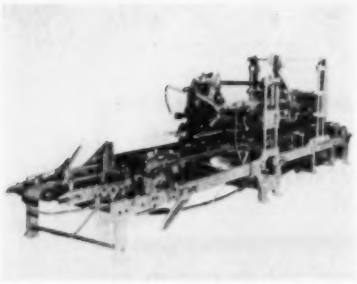
**FOR DETAILS**
See Weatherhead catalog in Sweet's Product Design File, Plant Engineering File, the Fluid Power Directory, or write direct.



**THE WEATHERHEAD CO., FORT WAYNE DIVISION**
Dept. A-6, 128 W. Washington Blvd., Fort Wayne, Ind.
In Canada:
The Weatherhead Co., Ltd., St. Thomas, Ont.

by reason for rejection to identify predominant batch defects. **Digital Equipment Corp.**, Maynard, Mass.

*Circle 420 on Page 19*



## Carton Gluer/Taper

Combination machine (Model 429) can be used as an automatic gluer or as an automatic taper. The basic machine consists of a gluer and sealer which comes equipped for sealing cases with glue. It is converted to a dual purpose machine by adding a Tape-Line system that automatically moistens, measures, cuts, and applies gummed tape at a rate up to 30 cartons per minute, depending on case and product requirements.

The gluing system used is a forced-feed method that applies the glue in stripes under light pressure through applicators, either continuously or in a skip-gap pattern. With the skip-gap method, an air cylinder raises the applicator at the precise moment the flap reaches the skip-gap position. The applicator is returned by an air cylinder to the gluing position after the skip-gap. The flap itself re-opens the valve allowing glue to flow. Two cams control air pressure that actuates the kicker to fold down trailing inner flaps. These cams are easily moved to adjust the kicker. The applicators rest on moist pads when the machine is shut down. This prevents glue from hardening inside the applicator and removes glue on the outside. The tape unit can be attached directly to the gluer channels or floor-mounted. It applies paper or reinforced tape in all standard widths up to 3 inches and features a self adjusting control which cuts tape to proper length automatically. **Portland Div., Emhart Mfg. Co.**, Portland, Conn.

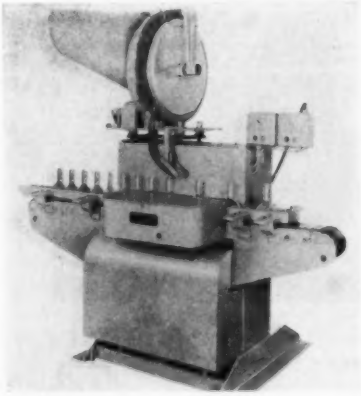
*Circle 421 on Page 19*

## High-Speed Weigher

Net weighing machine is designed for free flowing or semiflowing products in the food industry. It can handle from ¼ oz up to 20 oz. The machine can deliver weighed portions at speeds up to 70 portions per minute. A finished portion is delivered each 12 revolutions of the input drive shaft. The weigher has eight scales glove-fitted in a merry-

go-round arrangement under a single variable feedback control. In operation, the unit receives a portion in one tray while simultaneously others are being trimmed, checkweighed, and emptied into a package or carton. The machine levels off packed or fluffy variations and maintains an even weight on the main supply vibrator. **Olofsson Corp.**, 2727 Lyons Ave., Lansing, Mich.

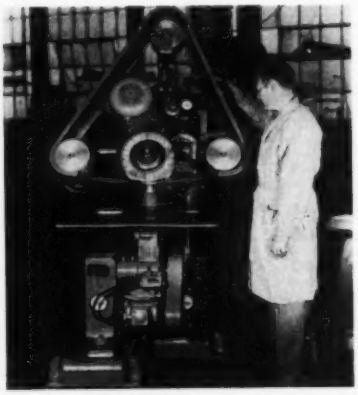
*Circle 422 on Page 19*



## Fitment Applicator

Equipment is designed for installations where the fitment is the sole closure, usually items for the drug and pharmaceutical industry. It can be integrated into a conveyorized packaging line following a filling machine. The machine handles solid or perforated plastic fitments, orienting them from a hopper into a chute. The passing container picks up the fitment which is then firmly fixed onto the container. Equipment operates on a no-container, no-pick-up principle, Straight line movement plus firm gripping of containers by rubber faced belts during the entire operation prevents spillage. Production rate for Model FAB is 20 to 120 fitments per minute, depending on the container size. Other machines are available with capacities of up to 300 applications per minute. **Resina Automatic Machinery Co. Inc.**, 572 Smith St., Brooklyn 31, N. Y.

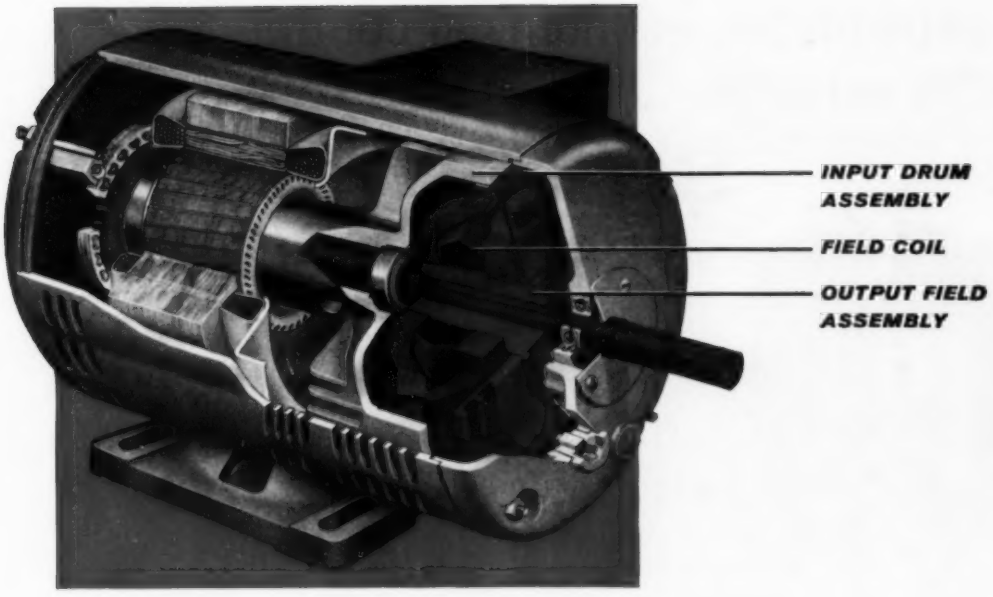
*Circle 423 on Page 19*



## Abrasive Belt Head

Abrasive head unit is designed for polishing contours, but it is also suitable for flat work. Model DLS can perform slack-belt operations as well as jobs which require the backing-up of the abrasive belt with a contact wheel or platen. An air cylinder maintains and adjusts belt tension on the tracking pulley which is adjusted by a hand knob. A pressure regulator, gage, and quick acting lever valve are included for control of the belt tensioning air cylinder. Abrasive belt length is 132 inches with the belt width and horsepower of the drive motor furnished to suit the application. **Divine Brothers Co.**, 200 Seward Ave., Utica 1, N. Y.

*Circle 424 on Page 19*




## Get Stepless Adjustable Speed from AC Power

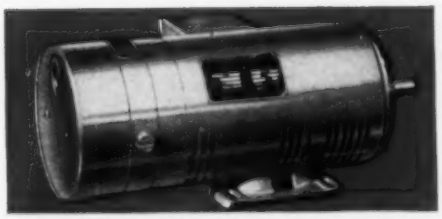
## with DYNAMATIC Fractional HP Ajusto-Spede® Drives

Wherever infinite adjustment and accurate control of speeds are required, Eaton-Dynamatic Ajusto-Spede Drives offer a simple, low-cost solution to the problem—stepless adjustment from zero to full output speed, and accurate control of any speed within the speed range.

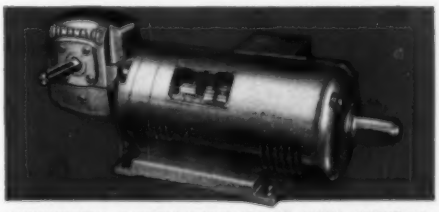
The Dynamatic Ajusto-Spede Drive is an integral combination of AC constant speed induction motor, eddy-current coupling, and plug-in type single-tube electronic control. Torque developed in the motor is transmitted to the driven member by electro-magnetic attraction; there is no mechanical contact between the driving and driven members.

Dynamatic Ajusto-Spede Drives operate on standard 115/230 volt, single phase, 60 cycle or 220/440 volt, 3 phase, 60 cycle alternating current—no special power source is required. Sizes are ¼, ½, and ¾ horsepower at 1600 RPM; ½, ¾, and 1 horsepower at 3200 RPM.

**With standard, special, or remotely mounted transistorized control, Dynamatic Ajusto-Spede Drives offer many worthwhile advantages not found in other methods of speed control. Send for illustrated descriptive literature.**



**DYNAMATIC AJUSTO-SPEDE DRIVE WITH ELECTRICALLY OPERATED BRAKE. With the safety type friction brake, it is possible to achieve rapid deceleration and quick stop, thus providing fast cycling operation.**



**DYNAMATIC AJUSTO-SPEDE DRIVE WITH INTEGRAL SPEED REDUCER. Because of the variety of gear ratios available in the reducer, this compact assembly is adaptable to a wide range of slow speed applications.**

**EATON** MANUFACTURING COMPANY — DYNAMATIC DIVISION

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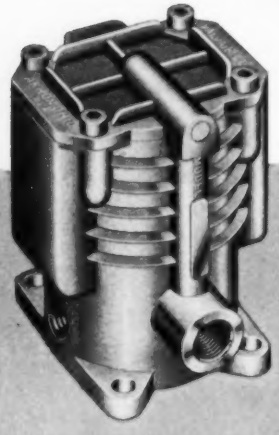
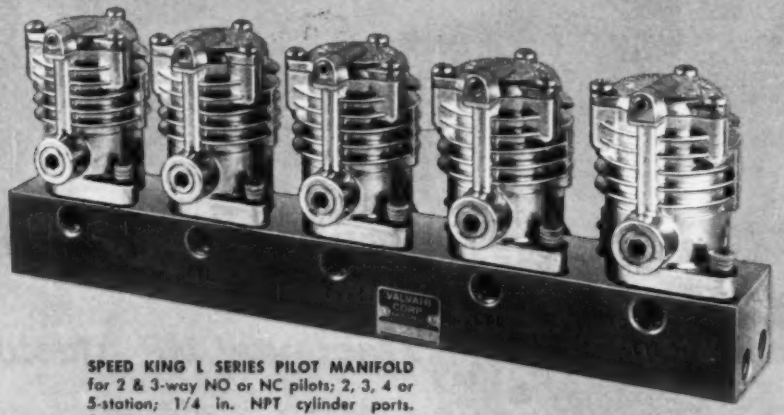
for dependable, economical control,
specify versatile...

# SPEED KING®

## SOLENOID PILOTS



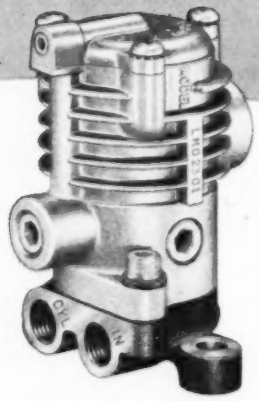
**SPEED KING P SERIES PILOT** 2 & 3-way NO & NC, 4-way; foot, sub-base or manifold mounting; 1/8 or 3/16 in. orifices. Foot mounting shown.



**SPEED KING L SERIES PILOT MANIFOLD** for 2 & 3-way NO or NC pilots; 2, 3, 4 or 5-station; 1/4 in. NPT cylinder ports. 5-station shown.

Compact Valvair® SPEED KING pilots are ideal for control of small air or vacuum-operated devices including cylinders up to 3 in. bore, as well as for piloting larger valves. Featuring Valvair's flow-thru cooling design, they offer multi-million cycle dependability, with solenoid coils guaranteed against burn-out for the life of the valve. Choose from a full range of types, mounting styles and sizes; integral junction boxes (L Series only) and manual over-ride optional; coils for ac or dc, any voltage.

Solve your small unit control problems with SPEED KING solenoid pilots. Your Valvair or Bellows Field Engineer can recommend a size and type exactly suited to your requirements.



**SPEED KING L SERIES PILOT** 2 & 3-way NO & NC; foot, sub-base on manifold mounting; 1/16 to 1/8 in. orifices. Sub-base mounting shown.

**Bellows-Valvair**

*The Bellows Co. • Valvair Corp. Akron 9, Ohio*

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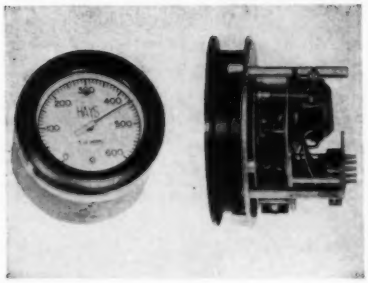
# AUTOMATION new components

**Parts, elements and devices designed for creating more automatic systems.**

**For detailed information and literature, use card page 19.**



## Remote Receiver

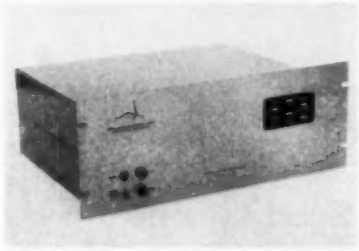
ROUND dial receiver is designed for remote indication of gas and liquid pressure, draft, differential pressure, flow, temperature, and liquid level. With the use of remote electric transmission, the danger of high pressure and temperature lines at panel boards is eliminated and impulse piping requirements are reduced to the short length needed between the point of measurement and the transmitter. Model 731, developed by **Hays Corp.**, Michigan City, Ind., has a speed of response of 2.5 seconds for full scale travel or better. Sensitivity is 0.1 per cent of full range or better, with calibrated accuracy for flow being ±1 per cent of full range scale. For low, medium, or high pressure, and temperature, calibrated accuracy is ±2 per cent of full scale range.

All that is required between the transmitter and the receiver is a three-wire transmission line. A plug-in connector to the amplifier is its only external connection. Power supply to the amplifier is 115 v, 60 cycle, single phase, ac with a power consumption of 50 w. Transmitter power supply originates from the amplifier. Receiver is available in three sizes—4½, 6, and 8-inch diameters.

*Circle 425 on Page 19*

## Code Translator

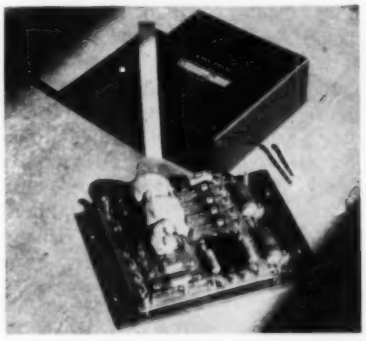
Instrument provides in-line digital data translation of straight binary-coded data into a binary-coded decimal form. Model 3-101 has a translation speed of 5000 word conversions per second. In operation, straight binary input data are accepted by the translator. Word length can be up to ten bits plus sign and of pulse or level configuration. Input conditioning circuitry incorporated in the unit provides matching of the data input to interval logic



levels. Simultaneously with the data flow an input trigger command synchronizes the translation operation with the input data flow. Trigger signals can be of various configurations, with adapting circuitry available. The translation process is completed by the unit, fully automatic, under control of an internal program.

The internal programming for translation and input and output commands is flexible and will conform to various system configurations. As each translation is completed, the result is displayed on the control panel and is available at the output of the instrument. The output figure is the binary-coded decimal data word plus sign and a *Ready* command. The *Ready* command is provided for proper control of the transfer of data to the output equipment (such as comparators, digital recorders, and digital display). **Applied Development Corp.**, 12838 Weber Way, Hawthorne, Calif.

*Circle 426 on Page 19*



## Magnetic Amplifier

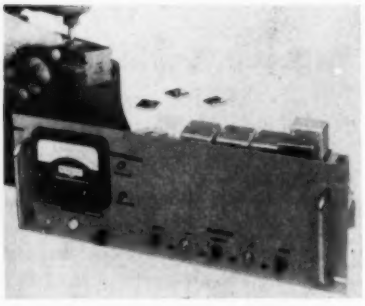
Linear magnetic amplifier is designed for instrumentation work involving low level transducers such as photocells, shunts, strain gages, thermistors, and thermocouples. Model 4511 consists of a dc to ac static converter and a double-ended center type magnetic amplifier which is excited by the converter. It has an output of ±10 v dc in response to signals of ±50 microamperes dc, with linearity of ±1 per cent in this range. Its nominal termination load is 2000 ohms. Amplifier is suitable for driving dc meters and electromechanical recording instruments. No filtering of the output is required for operation of meters and recorders, since its dc output is a pulse width modulated series of pulses with a basic 6 kilocycle repetition rate. **Control, Div., Magnetics Inc.**, Butler, Pa.

*Circle 427 on Page 19*

## Plug-In Limit Switch

Unit contains two 2-circuit double-break switches which can control four isolated circuits. A roller lever actuator arm operates one of the switches when rotated to the left; the other when the actuator is rotated to the right. Actuator arm is adjustable through 360 degrees, positively locking in any position. The switches and terminals are mounted in diecast aluminum housings. Switch can be replaced in a few seconds because of the plug-in feature, which has the mounting block permanently wired and mounted on the machine. **Micro Switch, Div., Minneapolis - Honeywell Regulator Co.**, Freeport, Ill.

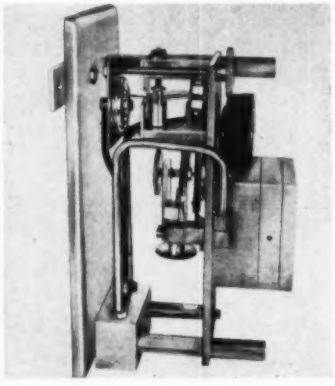
*Circle 428 on Page 19*



## Meter Relay

Meter relay, capable of controlling up to 600 w of output power can be activated by signals as low as 2 mu w. Driven from low-level electrical signals, or the output of differential transformers, strain gages, gas analyzers, bridges, temperature-sensitive elements, or photocells; unit can sort, grade, classify, alarm, indicate, or control. An example of an application is the automatic classification of close-tolerance products made by machine tools. In operation, as the product is slid into a gaging head, its tolerance class is rapidly shown on one of five indicator lamps on the relay panel. It can perceive a 0.00005-inch thickness change on the basis of less than a 2 mu w signal change from the gaging head. Each unit can be equipped with up to nine classification indicators. The output power can be fed back to the machine tool to correct deviation from the nominal tolerance before the *Reject* class is reached. **Electric Regulator Corp.**, Pearl Street, Norwalk, Conn.

*Circle 429 on Page 19*



## Signal Converter

Position balance type transducer can convert any input pneumatic signal into a corresponding output signal of different characterization. Its most frequent use is to convert a square root input into a linear output. In operation, Model 850 receives any square root or other pneumatic signal in the range of 3-15 psig and uses this pneumatic signal to position a sensing cam. A pneumatic tracing device senses the profile of this characterized cam and, through a relay, transmits a converted pneumatic signal corresponding to the cam. Sensitivity of the unit is better than 0.2 per cent, speed of response less than 0.5 second, ambient temperature effect is less than ½ per cent in output for 50 F ambient change. **Brooks Rotameter Co.**, P. O. Box 432, Lansdale, Pa.

*Circle 430 on Page 19*

## Proximity Pickup

Miniature probe-type proximity pickup can detect moving metal pieces passing it at a rate up to 60,000 pieces per minute. It can detect both ferrous and nonferrous metal parts having a diameter of less than 1/10 inch and can be excited by gear teeth of 10 diametral pitch. Mounted at the point of work, Model 4914 WPL has a 10-foot cable potted in place. This cable connects to a proximity control unit. When metallic workpieces are in close proximity to the pickup, the associated control unit supplies an electrical pulse or relay closure that governs mechanical, electrical, or electronic equipment. **Electro Products Laboratories Inc.**, 4500 N. Ravenswood Ave., Chicago 40, Ill.

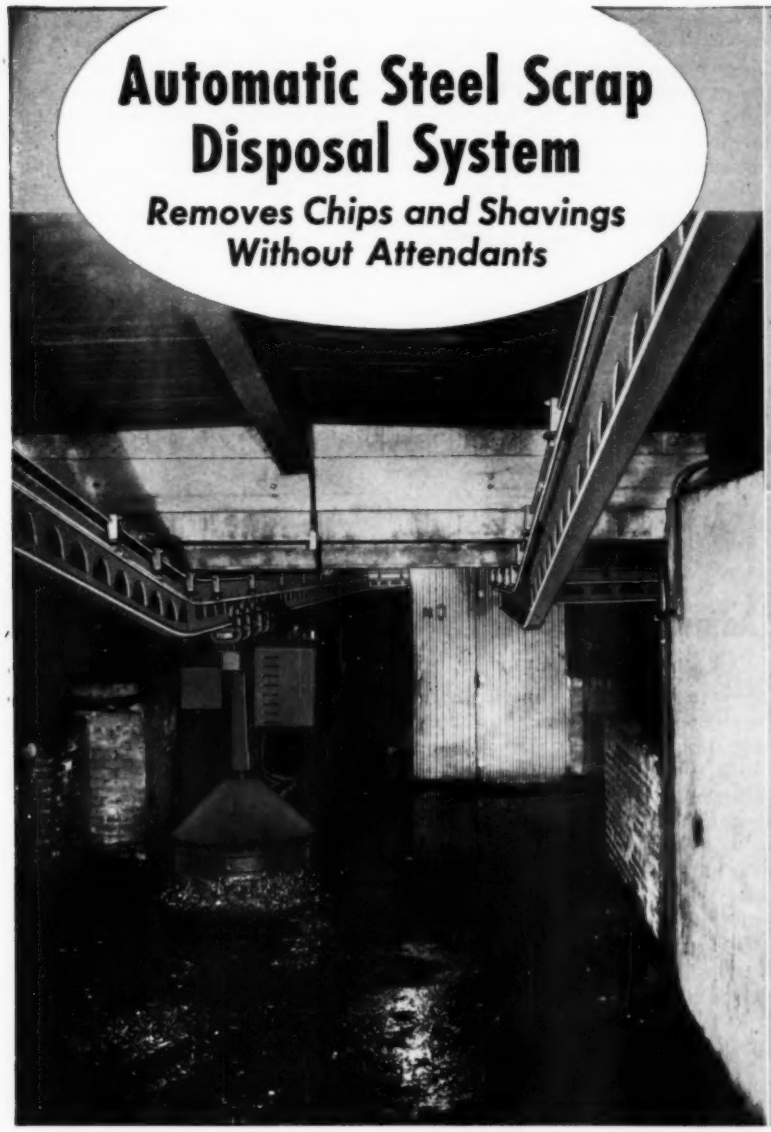
*Circle 431 on Page 19*

## Shaft Position Encoder

Device provides 1200 positions in a 320 degree revolution in binary coded decimal code. Nominal readout speed is 60 rpm, with the use of readout equipment a maximum of 200 rpm is possible. The scan-

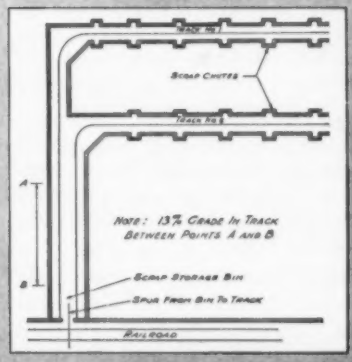
# Automatic Steel Scrap Disposal System

## *Removes Chips and Shavings Without Attendants*



A load of scrap about to be dropped in bin. Carrier immediately reverses after unloading and starts another trip.

View of tracks near beginning of tunnels. Carrier is shown approaching track incline on way to bin with a load.




ONE carload of metal chips and shavings is picked up and moved daily with an automatic Cleveland Tramrail magnet-carrying system that operates unattended in two parallel tunnels under metal-working machines.

Each tunnel has its own Tramrail track on which a magnet carrier travels back and forth, picking up scrap that comes down from the machines on floor above. The scrap is conveyed to a bin next to a railroad siding. The system was put into operation in 1942 and has proven an extremely efficient and low-cost method for ferrous scrap disposal.

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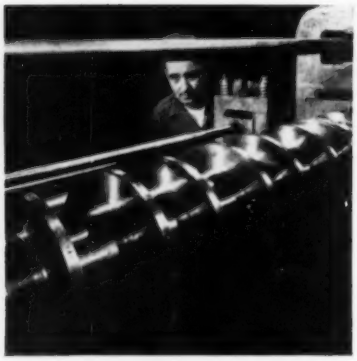
Write us for your free copy of "AUTOMATIC DISPATCH PORTFOLIO" Gives data on a variety of cost-reducing automatic handling installations.

**CLEVELAND TRAMRAIL DIVISION**
THE CLEVELAND CRANE & ENGINEERING CO.
1385 East 284th Street. Wickliffe, Ohio

**CLEVELAND TRAMRAIL**
**OVERHEAD MATERIALS HANDLING EQUIPMENT**


*Circle 701 on Page 19*



## Yoder Rotary Slitters reduce inventory... speed production

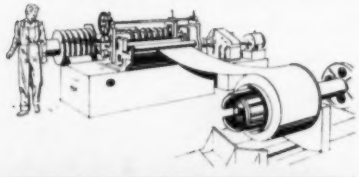
To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths... completely engineered lines for special requirements.

YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the YODER Slitter Manual.

Investigate the many advantages of YODER-engineered Slitter Installations. Write today for this comprehensive, 80 page YODER Slitter Manual... it's yours for the asking!

**THE YODER COMPANY**
5526 Walworth Avenue • Cleveland 1, Ohio



ENGINEERING YODER MANUFACTURING ROTARY SLITTING LINES

Circle 702 on Page 19


ning rate is limited only by the readout device. Low-pressure sliding contacts give high current carrying capabilities. Model C-139 will operate under ±8g to 1000 cps and withstand and operate under 100g steady state in any axis. **Datex Corp.**, 1307 So. Myrtle Ave., Monrovia, Calif.

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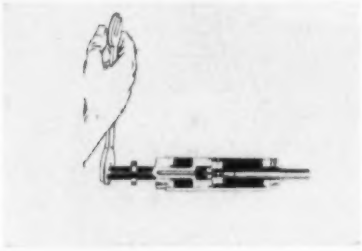

## Adjustable Cylinder

Stroke of air and hydraulic cylinder can be shortened or lengthened, with micrometer accuracy, by adjusting the rod. Cylinder is of steel construction with bearing surfaces of bronze. End plugs are tapped for universal mountings. Unit is available for air to 150 psi, hydraulic up to 500 psi in 1½ to 8-inch bore sizes with standard 2 to 1 or oversize rods. **Ortman-Miller Machine Co.**, 19 143rd St., Hammond, Ind.

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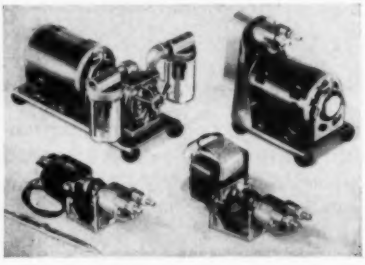
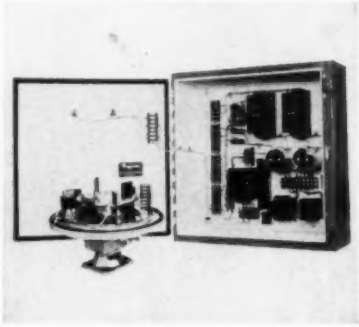


## Pumps/Compressors

Line of miniature vacuum pumps and air compressors that require no oil is furnished in two basic types with a choice of five rotary vane models. Feature of the units is a carbon vane which lubricates itself, producing an oil-free air blast or exhaust. The smallest air pump (Model 0330) is furnished with a choice of three motors: Series wound motor that delivers up to 0.67 cfm running open and up to 20 inches Hg vacuum or 10 psig; split phase motor with belt drive and *piggy back* pump mounting that delivers 0.48 cfm and up to 20 inches vacuum or 15 psig; and a shaded pole motor that produces 0.35 cfm or vacuum up to 20 inches and pressure up to 10 psig. Largest model in the line produces up to 1 cfm. Further details are given in Bulletin M-VP 15. **Gast Mfg. Corp.**, Benton Harbor, Mich.

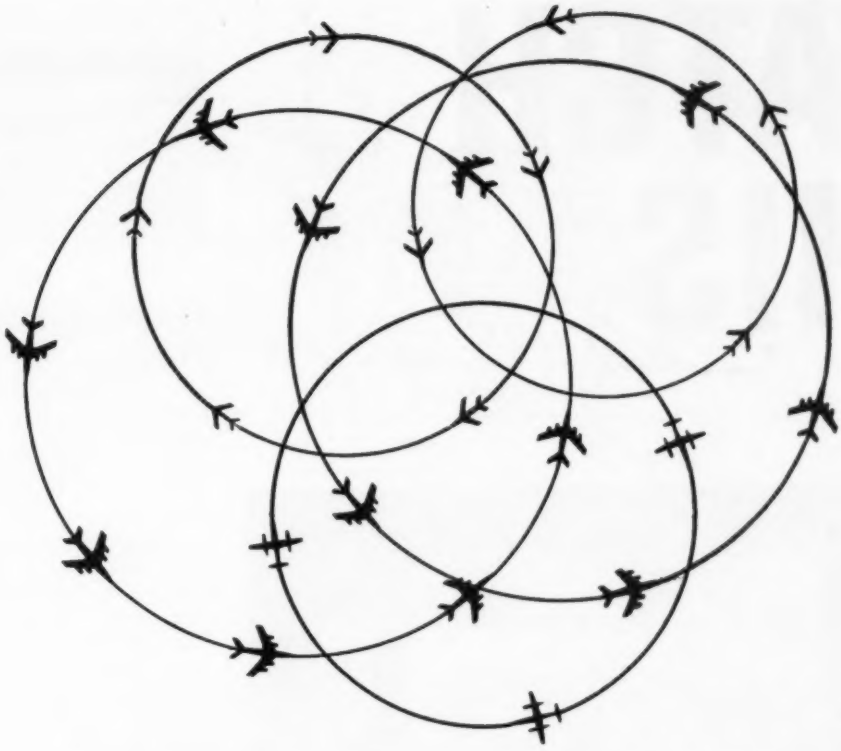
Circle 434 on Page 19



## Magnetic Disc Memory

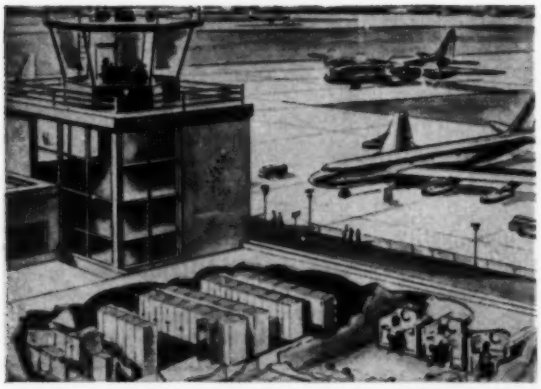
Magnetic disc memory has a speed performance from 1000 fpm down to a dead stop due to the use of static flux detector heads with 1200 cycle reset frequency. It is capable of furnishing *On-Off* control of product line operation at a fixed station downstream from a measurement station. In operation, static flux detector read heads generate a high level output signal independent of disc speed. The disc is mechanically coupled to the product line in such a way that disc rotation between the input and output heads matches the product travel between stations. Dual polarity recording on two concentric tracks permits four distinguishable output responses. Magnetic energy storage limits each track capacity to 75 discrete signals between input and output heads with an 8-inch diameter disc. Multiple inspection and action points along the production line can be handled by additional write and read heads around the memory disc. **Automation Inc.**, 212 Worcester St., Wellesley Hills 82, Mass.

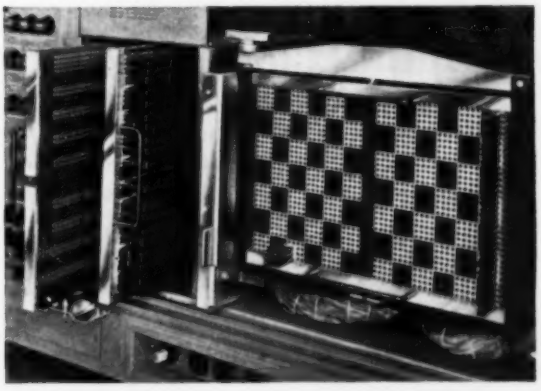
Circle 435 on Page 19



## Volscan juggles 24 aircraft with AMP Programming

Reliable is the word for Volscan. Designed and built by Avco's Crosley Division to handle a tough job, it juggles up to 24 aircraft at the same time—6 inbound and 18 outbound. It's big, complex and completely trustworthy. It was this need for reliability that led Crosley engineers to call out the AMP Universal Patchcord Programming System. Used in the Syscom Schedule Correlation Unit AMP Programming shunts such vital data as range, azimuth, slope, level out and no passing zones into the computer. There's a host of unusual features in our Programming Systems that were needed on the Volscan—features that can help you, too, make better, safer equipment: universal, or shielded construction, positive wiping action between pins and springs, almost unlimited versatility and uniform electrical characteristics to meet the most exacting requirements. **Our Patchcord Programming Catalog tells the whole story. Send today.**





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**GENERAL OFFICES: HARRISBURG, PENNSYLVANIA**

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Germany • Holland • Italy • Japan

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Data Processing in Paper Mill

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- Property Protection • Material Handling
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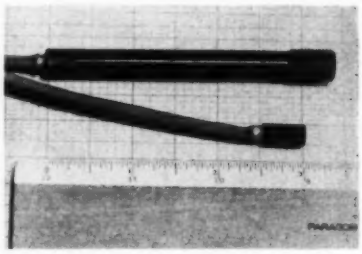
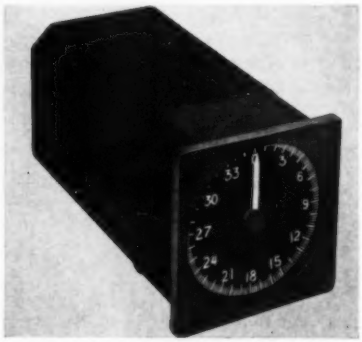
PLEASANTVILLE, NEW YORK

## Temperature Sensor

Instrument measures temperatures at precise in-wall locations of steel structures which have a section thickness of ¼ inch or greater. Sensor is available with body materials of 1020 steel, ASTM-A7 steel, 4130 steel, and 303 stainless steel. Leads are 10 inches long No. 28 E & S, glass-asbestos insulated. Body lengths are available in ⅛-inch increments from ¼ to 3½ inches. Thermocouple junction location, which is determined to ±0.002 inch or less, is available in increments of ⅛ inch from 0.001 inch of heated surface to 0.005 inch from unheated surface. **Advanced Technology Laboratories, Div., American-Standard,** 369 Whisman Rd., Mountain View, Calif.

*Circle 436 on Page 19*

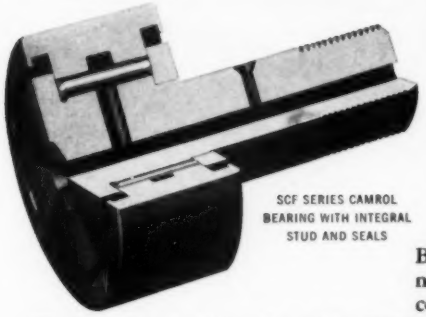


## Converter Indicator

Digital-to-analog converter indicator consists of a relay matrix, a $2^9$ analog-to-digital converter, and a 400 cps, 115 v motor. It is suitable for machine control applications and for monitoring of digital computers. The analog output is 360 degrees on a dial. Feature of the instrument is minor arc sensing, a function which enables the analog movement to proceed

**AUTOMATION TIPS**
by McGill

# *Specify* **CAMROL**® bearings with assurance of improved performance—dependable long life

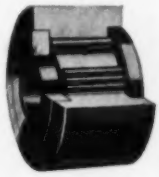


SCF SERIES CAMROL BEARING WITH INTEGRAL STUD AND SEALS

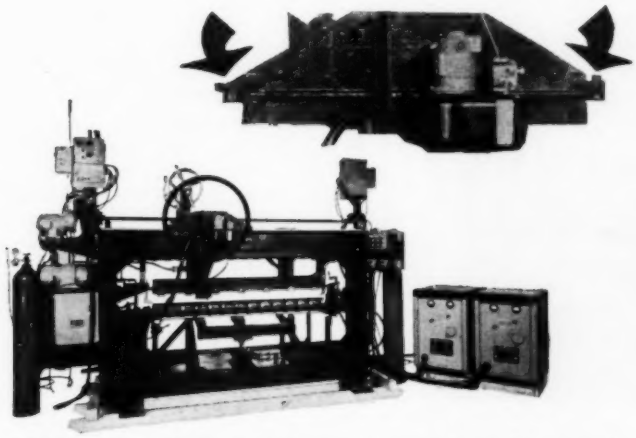
McGill CAMROL bearings are proven with over 25 years' application experience and gradual product improvement. You can rely on their designed-in ability to accept the intermittent shock and heavy load of cam action, guide and support roller applications.

Built for stock in roller diameters from ½" to 4", CAMROL bearings eliminate the procurement and assembly of bolts, rollers, end washers and similar components of improvised followers.

The CF series (with stud) and the CYR series (for shaft mounting) are available also with integral seals for protection against contamination. Lubricant is retained to avoid frequent relubrication. The following are typical of millions of CAMROL bearings serving industry. Ask McGill engineering to held with your automation problems.



CYR SERIES CAMROL BEARING FOR SHAFT OR YOKE MOUNTING

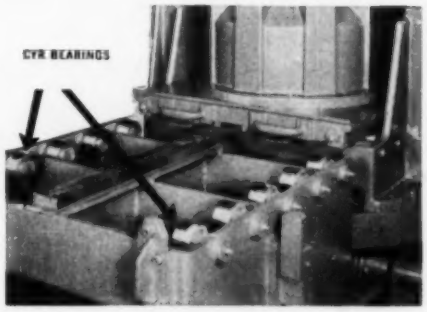


## CAMROL CF bearings insure smooth and accurate indexing of welding carriage for ACRO WELDER

ACRO WELDER MANUFACTURING COMPANY uses McGILL bearings in many applications to reduce friction, minimize wear associated with plain bearings and assure accuracy in their welding machines.

In the special purpose welder shown, sealed CAMROL bearings support and guide the linear indexing carriage with assured accuracy and reduction of friction. Integral seals protect bearing life and cut re-lubrication needs.

The 300 pound carriage indexes at a speed of 200 IPM through a 5" distance and is then slowed to a speed of 100 IPM for a 1" weld length, accomplishing 476 welds to join 17 bars to 14 cups. CAMROL bearings help improve machine performance that cuts welding time from five to 1/3 of a man-hour per assembly.



CYR BEARINGS

## *CAMROL CYR bearings are trouble-free and accurate in NATCO machines*

The photo shows CAMROL CYR Series which support and convey jig-type fixtures into NATIONAL AUTOMATIC TOOL COMPANY multi-spindle machines which drill and ream stainless steel weldments for jet engines.

Twenty-four CYR bearings reduce friction and provide smooth trouble-free and accurate operation in these machines.

NATIONAL AUTOMATIC TOOL COMPANY reports that performance of McGill CAMROL bearings has been excellent and that they have "never had a service report as to the malfunction of a McGill bearing."

*engineered electrical products*

**McGILL**®

*precision needle roller bearings*

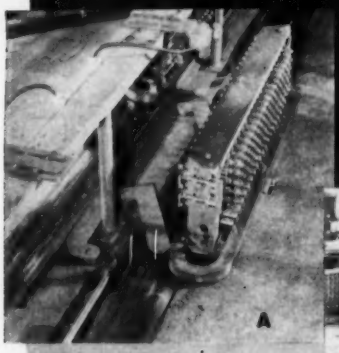
*Send for Free Bearing Catalog No. 52-A for complete data.*

**MULTIROL-GUIDEROL-CAMROL-CAGEROL**

McGILL MANUFACTURING COMPANY, INC.
BEARING DIVISION, 401 N. LAFAYETTE STREET, VALPARAISO, INDIANA

# SANDVIK
## STEEL BELT CONVEYORS

*Make More Kinds Of Automation Possible*



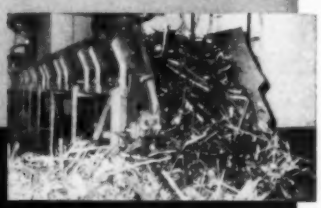
**At Western Electric's Omaha Works, Sandvik "Tru-Track" steel belt conveyors 130' and 150' long are used in assembly tables for crossbar switches. These switches weigh up to 57 pounds and are mounted on roller carriages for rolling on and off the moving steel belt. Photo (A) shows how pneumatically-operated pusher arms move carriage off belt at each work station. Pushers are actuated by a limit switch tripped by a removable magnet on top of unit.**

The inherent abilities of the solid, cold rolled carbon steel band used on Sandvik conveyors open the way to new automated operations.

The smooth, hard, impervious surface of the flat steel belt

- Resists Oil, Heat and Abrasion
- Simplifies Automatic On-Off Sliding and Live Backlogging
- Can Be Easily Fitted With Simple Guide and Discharge Devices
- Has High Load Capacity and Long Service Life
- Belt Can Be Any Length

**Sandvik "Tru-Track" steel belt conveyor handling metal scrap. Accurate, straight-line tracking of belt combined with angled side plates prevents pieces from getting wedged between side plates and belt . . . thus making automated operation possible.**



SANDVIK STEEL BELT CONVEYORS

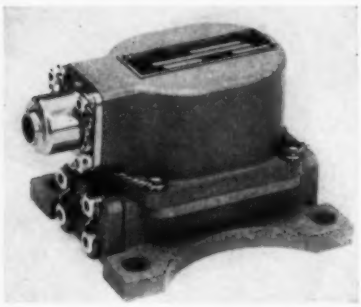
**SANDVIK STEEL, INC.**

Steel Belt Conveyor Department
1702 Nevins Rd., Fair Lawn, N. J. SWarthmore 7-6200
Cleveland • Chicago • Detroit • Los Angeles

IN CANADA: Sandvik Canadian Ltd., P.O. Dr. 1335, Sta. O., Montreal 9, P.Q.


through the shorter angular distance to reach a null position. Accuracy of the unit is ±½ degree. **Kearfott Co. Inc.**, 1500 Main Ave., Clifton, N. J.

Circle 437 on Page 19



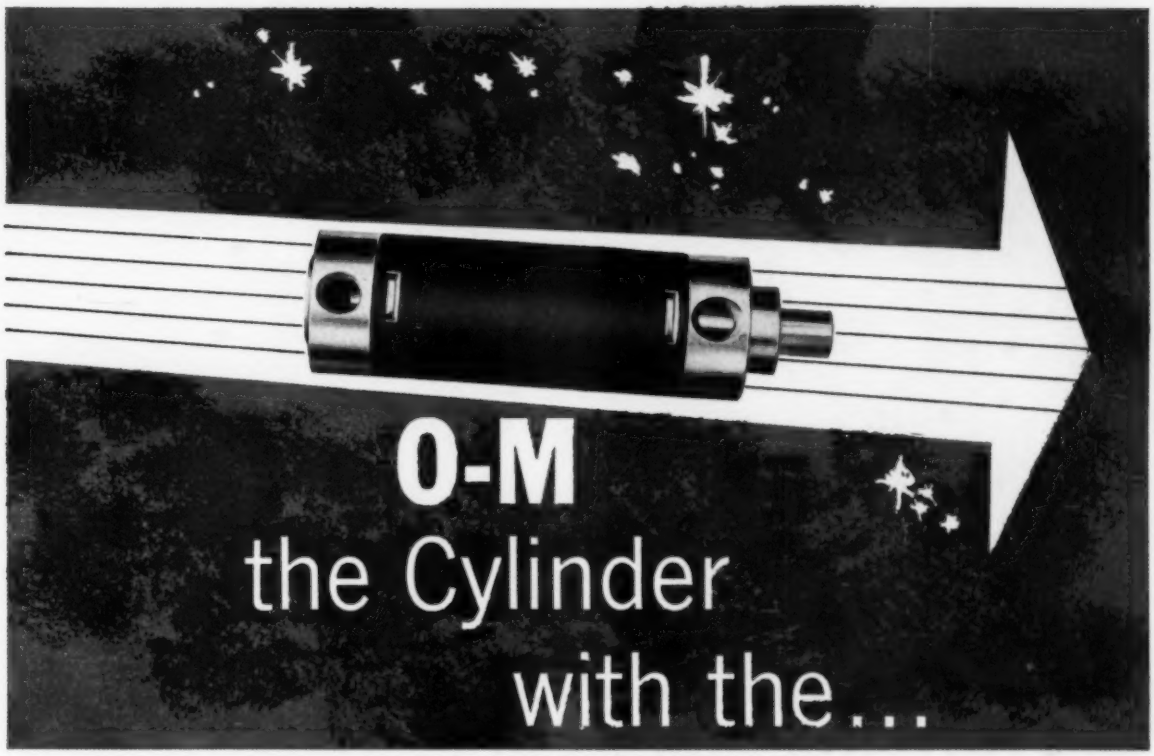
## Servovalve

Electrohydraulic servovalve features a nozzle-flapper hydraulic amplifier and mechanical feedback arrangement. Designated the Series 30, unit uses a small second stage spool and bushing contained in a lightweight aluminum body. Its maximum flow capacity is 3 gpm at 3000 psi. The subminiature unit is provided with standard mounting details which allow it to be used interchangeably with servovalves on existing systems and test equipment. Small mounting feet can also be furnished. **Moog Servocontrols Inc.**, East Aurora, N. Y.

Circle 438 on Page 19

## Digital Readouts

Miniature incandescent digital readouts display the digits zero through nine (on a 1 by 1-inch area) instantaneously with the lighting of each bulb. Model LD-11, designed for panel mounting, is available with white-on-black or black-on-white numerals. It operates on an adaptation of the lenticular optic




# Guided Stroke

## INTERNAL KEY TIE-RODLESS-TYPE SERIES 101A

*Air 150 psi—Hydraulic up to 1500 psi*
*Fits where others won't*
*Meets JIC Standards, Bulletin 101A*

WHEN a piston rod must hit right on the button to feed a work piece, activate an indexing table, push, pull, raise, lower, knock-out or clamp, you can count on an O-M Guided-Stroke Cylinder everytime. And there's no mystery about it, just top-level O-M precision workmanship, the latest and best machine tools, modern design, plus years upon years of engineering "know-how." And it's all spelled out with construction and performance details, engineering drawings as well as a capacity chart in each of our latest Bulletins.

Write for your copy TODAY. See why O-M Air and Hydraulic Cylinders maintain perfect rod alignment, make full-power starts, are designed right to seal right, have the lowest coefficient of friction and many other advancements.

**Bulletin 101A** for Internal Key Tie-Rodless-Type Air and Hydraulic Cylinders featured above.

**Bulletin 105A**—Improved Tie-Rod (Heavy Duty) Cylinders Hydraulic 2000 psi; 3000 psi non-shock.

**Bulletin 107**—Automation (Heavy-Duty) Air Cylinder for 200 psi operation.

**Bulletin 108**—Automation (Heavy-Duty) Hydraulic Cylinder—for 1000 psi operation.

*All O-M Cylinders are available in ½" to 8" bores with standard, oversize, or heavy-duty rods. Complete line of mounts and interchangeable parts. Immediate delivery on most sizes. MAIL COUPON TODAY.*

**ORTMAN-MILLER MACHINE COMPANY**
**25 143rd Street, Hammond, Indiana**

☐ Have representative call

Send Bulletins

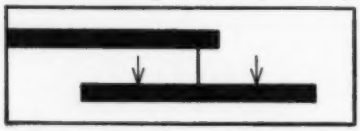
☐ 101A ☐ 107
☐ 105A ☐ 108

NAME_____ POSITION_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

# How did this team solve an age-old weighing problem?

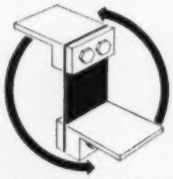
Since 5,000 B.C. men have been trying to devise a pivot balance that would be highly sensistive yet remain accurate. The breakthrough came in 1956 when the United States issued a patent for a "Thayer Flexure Plate" Leverage System. A team of engineers and businessmen, aware of industrys great cumulative loss of materials in weighing operations, had invented a revolutionary new scale.

Knife-edged pivots that progressively wear and change were replaced by Thayer Flexure Plates that move only .001", yet accurately reflect the minutest changes in weight. This *firmly joined* lever withstands shocks and vibrations indefinitely. Dirt and dust are no longer a problem. Thayer guarantees this leverage system accurate for the life of the scale.



**How Can It Save You Money Year After Year?**

Working in conjunction with straight electrical controls, it forms the most reliable, low maintenance system ever devised to control processing or materials handling *by weight*. Literature on its application to filling, batching and checkweighing operations is available on request.



THAYER SCALE

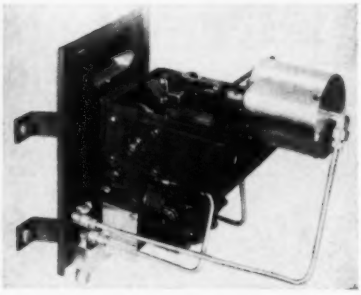
AUTOWEIGHTION SYSTEMS FOR FILLING BATCHING AND CHECKWEIGHING

THAYER SCALE CORP. THAYER PARK PEMBROKE, MASS.

A Subsidiary of SUNDSTRAND CORPORATION

technique which eliminates the need for projection lenses. The bulbs used are designed for operation from 2½, 6, 12, or 28 v systems. **Electronic Tube Div., Burroughs Corp.**, P. O. Box 1226, Plainfield, N. J.

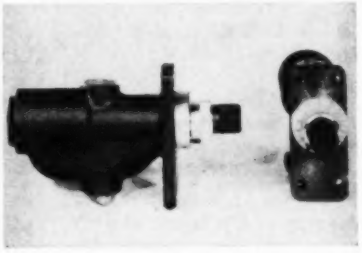
*Circle 439 on Page 19*



## Computational Relays

Line of pneumatic computational relays is designed for square root extracting and for squaring. Model VSR extracts square root down to 10 per cent of output span, and Model VS forms squares from 1 per cent of output span. Both relays have input and output ranges of 3 to 15 psig with air consumption of 0.2 scfm and nominal error of 1 per cent of output span. Units feature high-gain integral pneumatic amplifiers which simplify piping, reduce the number of air sets per system, and reduce air consumption. **Republic Flow Meters Co., Subsidiary, Rockwell Mfg. Co.**, 400 N. Lexington Ave., Pittsburgh 8, Pa.

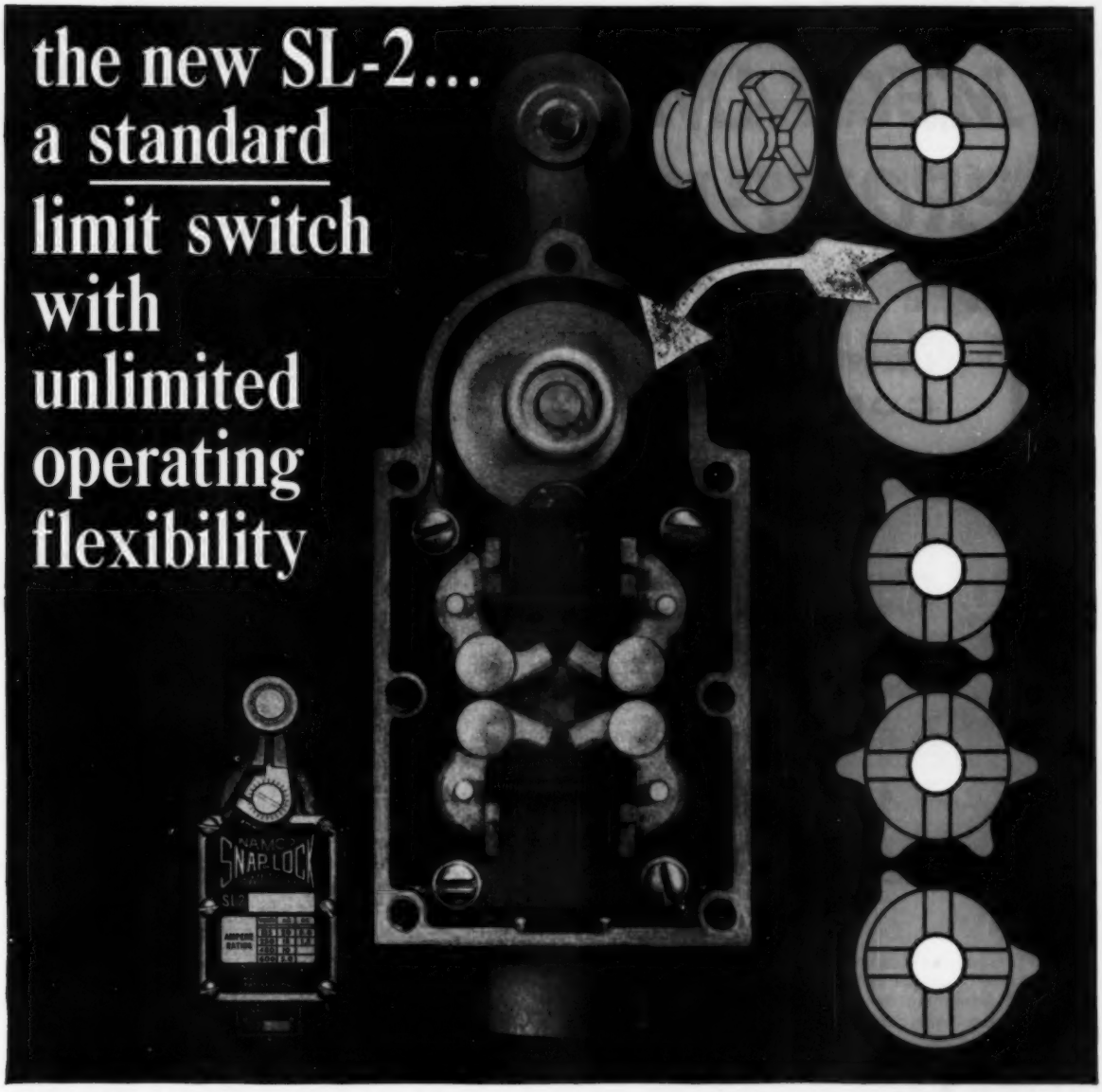
*Circle 440 on Page 19*



## Flow Regulator

In-line regulator can control rates of flow as low as 2 cubic inches per minute with an accuracy of ±10 per cent over a pressure differential of 1000 psi. It is applicable on machine tools, drill press feeds, air-

# the new SL-2... a standard limit switch with unlimited operating flexibility




Tailor limit switch performance to your specific job with NAMCO'S *standard* SL-2. This "machine life" limit switch features a standard cam blank which can be cut into a wide variety of configurations to meet any application. These interchangeable cams provide positive control of contact sequence; let you match switch operation to your specific job. Ruggedly built, oil-tight and moisture-proof, the SL-2 provides dependable, accurate performance that meets your most precise requirements.

**Now available for low-current, high-shock, excessive-vibration applications...the SLS-2...** with full-wiping, self-cleaning sliding contacts that insure "everytime" operation under conditions that spell machine downtime for other limit switches.

Get all the details on how the NAMCO SL-2 line eliminates limit switching problems for good. Write for Bulletin EC-SL260, or contact one of our representatives. You'll find them in all principal cities.

**National Acme**

THE NATIONAL ACME COMPANY
196 E. 131st STREET
CLEVELAND 8, OHIO

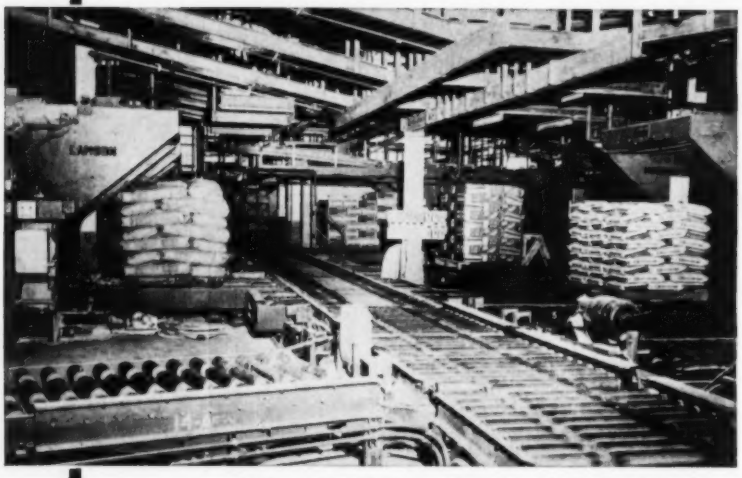
Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.



Circle 709 on Page 19

# MECHANIZE... PROFIT-WISE!

## WITH LAMSON ENGINEERED CONVEYOR SYSTEMS



Automatic Palletization — the hub of a LAMSON engineered conveyor system linking production lines to warehouse.

You cut production time and the unnecessary handling of materials to the bone with the help of LAMSON engineers. They are specialists in developing materials handling systems that truly increase the capacity of your present buildings and dramatically increase the productivity of your present equipment.

There are more LAMSON custom engineered conveyor systems in successful operation today than any other kind. They are being serviced throughout their life by the same LAMSON field offices that initially analyzed the problem, proposed the solution and supervised the installation.

As a result of this complete, professional service you will find many of the finest names in industry among LAMSON installations. During the past 75 years LAMSON has been active in almost every field, yours included, and perhaps even in divisions of your own firm. LAMSON can cut costs; speed production; increase your profits.

If you have a materials handling problem, write LAMSON today for our conveyor catalog and the name of your nearest LAMSON Field Engineer. Or, simply clip this advertisement to your letterhead and mail to:

PIONEERS *the Conquest* OF INNER SPACE

LAMSON

**LAMSON CORPORATION**

608 Lamson Street, Syracuse 1, New York

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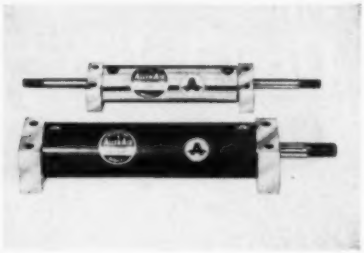
oil cylinders, instrumentation circuits, and test stands. A built-in check valve provides free flow with minimum pressure drop in reverse direction. The valve is adjustable between 2 and 90 cubic inches per minute, with positive lock at any flow setting. Maximum operating pressure for Model 1-4-2 is 2000 psi. Pressure required for regulated flow is 15 psi. Over-all pressure drop will vary from 15 psi at 2 cubic inches per minute to 40 psi at 90 cubic inches per minute. Unit can be panel or bracket mounted. **Fluid Power Accessories Inc.**, 2051 Railroad Ave., Glenview, Ill.

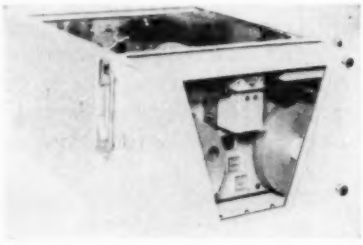
*Circle 441 on Page 19*



## Air/Hydraulic Cylinders

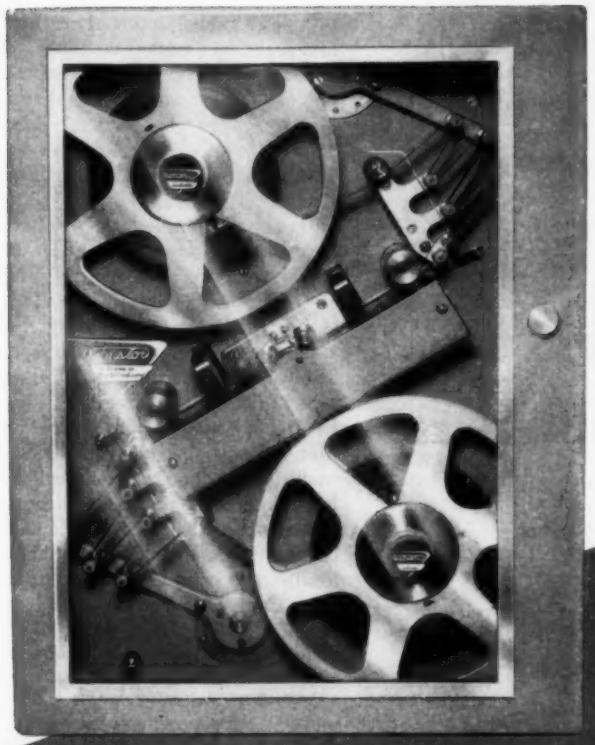
Line of air and hydraulic cylinders is available in bore sizes of $\frac{7}{8}$, $1\frac{1}{8}$, $1\frac{1}{2}$, and 2 inches. They are furnished as either double acting, or spring return, as well as double ended or single ended. Features of the unit are: One-piece square heads, ground and polished stainless steel rods, nylon bearings, and honed brass or steel tubes. Stroke sizes up to 168 inches are available. **Allenair Corp.**, 255 E. 2nd St., Mineola, N. Y.

*Circle 442 on Page 19*



## Tape Transport

Unit can be used as a tape reader for use in computer, communica-



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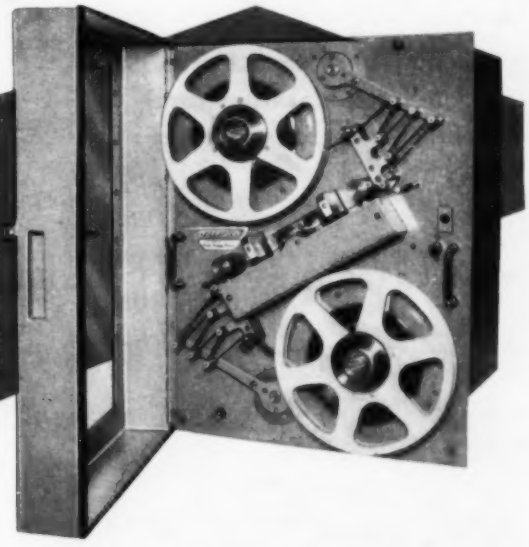

The Data-Stor Model 59 Digital Tape Transport is ideally suited for use in computer, instrumentation and control applications. It incorporates the highly reliable features of military tape transports developed by Cook Electric Company during the past 12 years, and has been proven in the Atlas, Titan, Polaris and other missile programs.
These features include exclusive use of modern ultra reliable solid state circuitry, eliminating gas or vacuum tubes. Precise tape handling is insured by proportional reel drive servo systems that have no jerky step servos. Tension error sensing is accomplished by synchro transmitters with no unreliable potentiometers or contact pile-ups. Field adjustments are eliminated by building tolerances into a single rugged tape deck casting. Endurance and quality are assured by strict adherence to the exacting design and workmanship requirements of MIL-E-4158.

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*Circle 711 on Page 19*

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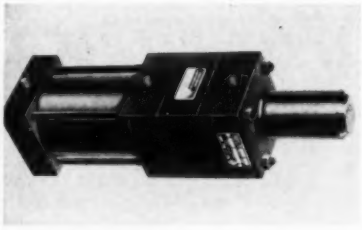
Circle 712 on Page 19

tion, and control applications. Either magnetic or punched tape read heads are available. Magnetic tape applications include both analog and digital modes. Features of Model 81 with photoelectric read head include: Automatic reel brakes, conductive leader end-of-tape sensor, automatic shutdown on reading lamp failure, tape breakage or tape runout sensor, and printed circuit electronics.

The photoelectric reading head system will accommodate 5, 6, 7, and 8 level codes. Integral adjustable tape guides will handle 11/16, 13/16, 7/8 and 1-inch wide tapes. Metered tape speeds of up to 75 ips, in either direction, can be furnished. It is capable of moderate stop/start times and can be controlled remotely by transistor logic signals or locally by pushbuttons. **Data-stor Div., Cook Electric Co.**, 8100 North Monticello Ave., Skokie, Ill.

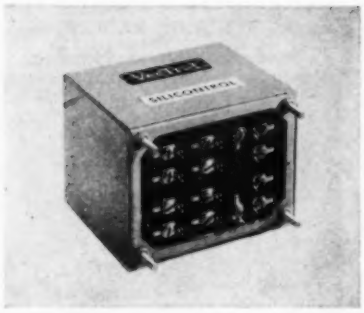
*Circle 443 on Page 19*



## Air-Hydraulic Booster

Device can boost ordinary compressed air (80 psi) up to 3000 psi hydraulic pressure. It is applicable for powering equipment such as spot welders, *C* frame riveters, hydrostatic testing equipment, workholding fixtures, and bench or arbor presses. It also provides control for workholding or clamping fixtures. Booster uses only air line pressure to obtain the intensified hydraulic pressure and it maintains this pressure indefinitely with no additional power consumption or generation of heat. Unit can be applied to both single and double-pressure circuits and it can be supplied with an integrally mounted tank. Installation is simple, requires no complicated piping or valves or controls. Unit has a stroking rate up to 200 cycles per minute. **S-P Mfg. Corp.**, 30201 Aurora Rd., Cleveland 39, Ohio.

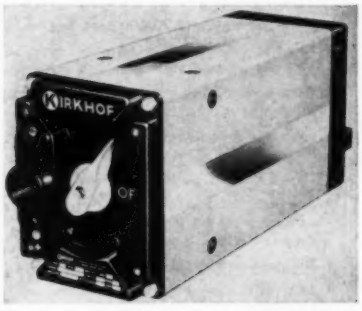
*Circle 444 on Page 19*




## Rectifier Control

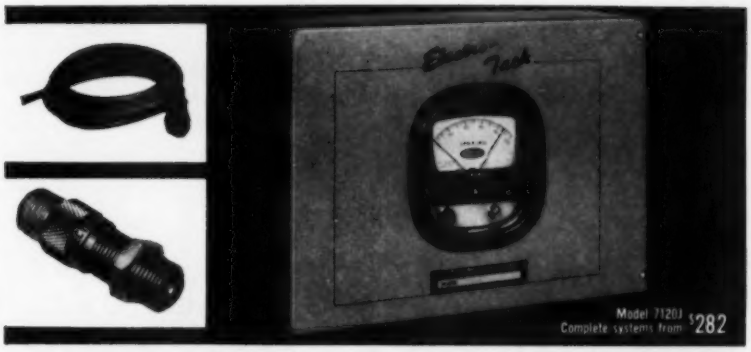
Device provides full range phase shift control of all makes and ratings of silicon controlled rectifiers—one or two, half or full wave, or inverse parallel, up to 70 amps each. Loss of control signal turns off the rectifiers. A supersensitive phase shifting network applies 60 cycle steep pulses of constant amplitude to rectifier gates and varies their phase angle over a full 180 degrees to control the rectifier output from zero to maximum. Pulse rise time is only a few microseconds. **VecTrol Engineering Inc.**, P. O. Box 1089, Stamford, Conn.

*Circle 445 on Page 19*




## Welding Transformer

Line of epoxy-insulated welding transformers is furnished with ratings of 60, 70, 90, and 130 kva. The epoxy insulation of the units makes a 110 C rise safe and practical for high production welding due to the method of impregnating the primary/secondary coil-and-loop assembly. The epoxy is chemically inert and is unaffected by moisture, hydraulic fluids, oils, acids, alkalis, and other deteriorating agents. A safety feature is that the tap switch assembly and secondary pad housing are formed of a high-impact,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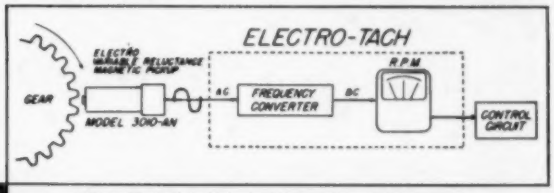


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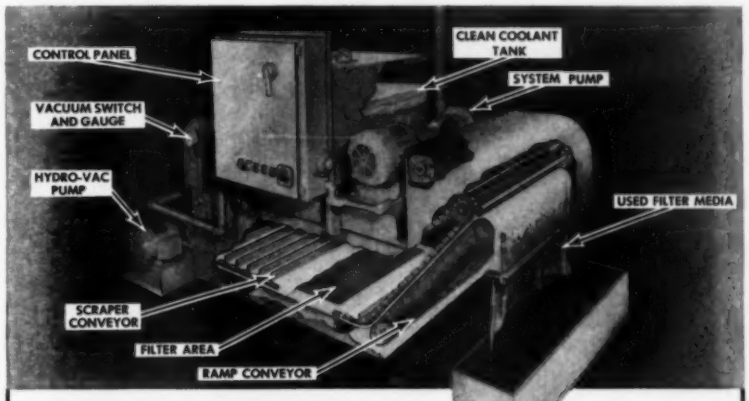
Canada: Atlas Instrument Corp., Ltd., Toronto, Ontario

*Circle 713 on Page 19*

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*Circle 714 on Page 19*

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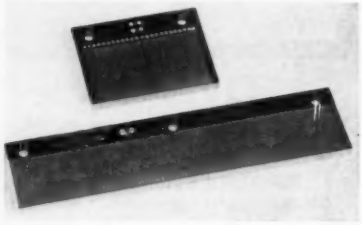
Circle 715 on Page 19

fiberglas-reinforced polyester that is nonconductive. The steel shell, housing the coil-and-loop assembly and the side and end surfaces of the secondary pads, are insulated by high dielectric epoxy coating. **Kirkhof Mfg. Corp.**, 2450 Buchanan Ave. S.W., Grand Rapids 7, Mich.

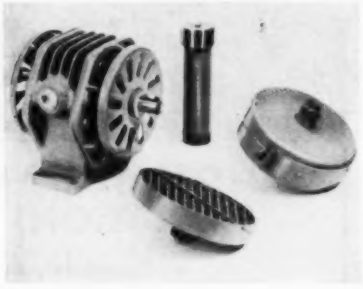
Circle 446 on Page 19



## Position Transducers

Line of all-metal Inductosyns (they were previously made of glass) provides a means for direct measurement and control of mechanical movements on machine tools. Accuracies of 40 microinches in linear and one second of arc in angle positioning are possible. Elements in the line include: Scales, sliders, rotors, and stators. The conductor patterns of the scales and sliders are of metallic copper 0.002-inch thick, secured to a thick metal base by an insulating bonding layer 0.0025-inch thick. **Farrand Controls Inc.**, 4401 Bronx Blvd., New York 70, N. Y.

Circle 447 on Page 19



## Dry-Air Pump

Rotary positive displacement dry-air pump is capable of supplying either pressure or vacuum for numerous processing applications. Pump is furnished in three sizes, ranging in capacity from 3.9 to 32.3 cfm. It is available with either single

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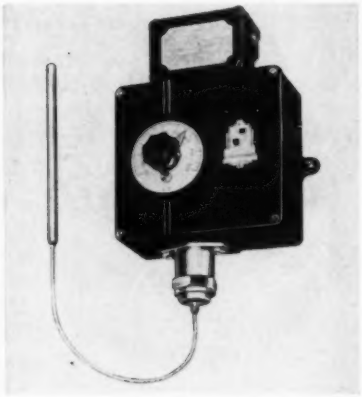
Circle 716 on Page 19

or double shaft extension and clockwise or counterclockwise rotation. Unit consists of four basic parts—body, left and right plates, and rotor. The high strength steel rotor shaft is integrally cast into the rotor. Four carbon alloy pump vanes, which seat into slots in the rotor by centrifugal force, are self-lubricating and operate with minimum friction. **Dri-Air Pump Dept., Conde Milking Machine Co.**, Sherrill, N. Y.

*Circle 448 on Page 19*

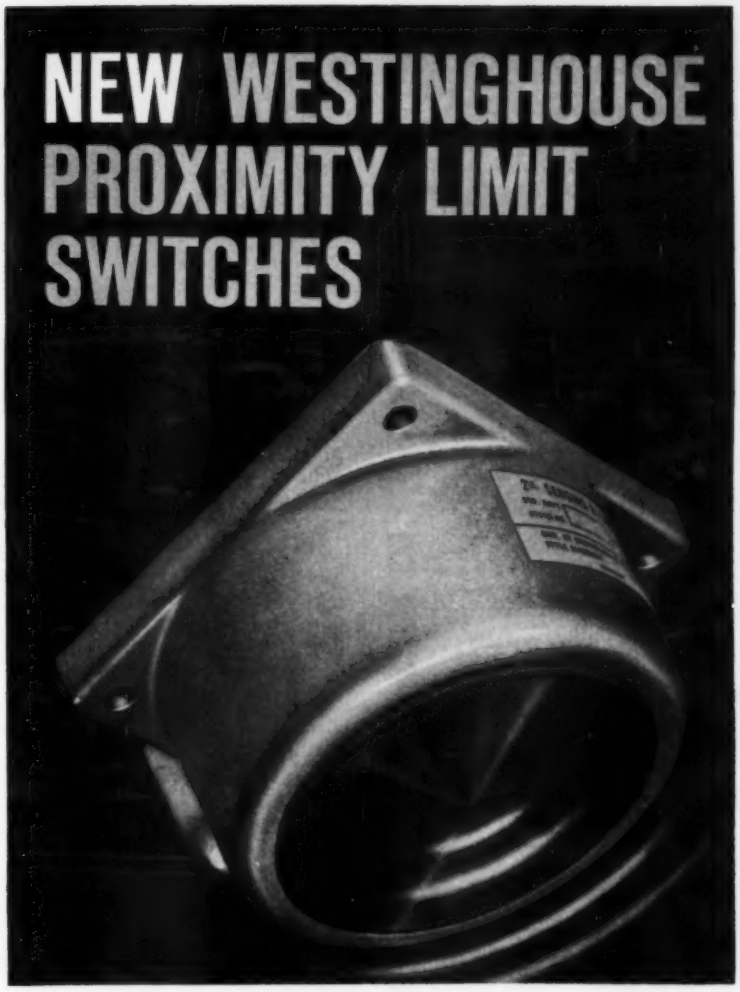


## Temperature Control

Designed for use in hazardous locations, temperature control is suitable for refrigeration or heating applications. Model GVS incorporates, in a sealed enclosure, a snap-acting switch which controls an electrical circuit that actuates valves, solenoids, motors, heating elements, or other appliances. Temperature is sensed by a mercury-filled thermal element placed in the medium to be controlled. Unit can sense and control temperatures from −30 to 1100 F.

In operation, expansion and contraction of the mercury reacts against a diaphragm in the element head, which in turn actuates a lever mechanism within the instrument to operate the snap-acting switch. A setting knob positions the actuating mechanism in relation to the switch by means of a precision cam, to establish the control point. The control can also be used to regulate the flow of a coolant to remove heat rather than supply it. **Partlow Corp.**, 534 Campion Rd., New Hartford, N. Y.

*Circle 449 on Page 19*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*Circle 717 on Page 19*

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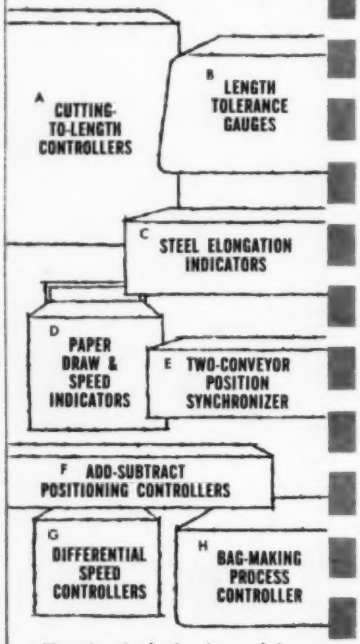
A CUTTING-TO-LENGTH CONTROLLERS
B LENGTH TOLERANCE GAUGES
C STEEL ELONGATION INDICATORS
D PAPER DRAW & SPEED INDICATORS
E TWO-CONVEYOR POSITION SYNCHRONIZER
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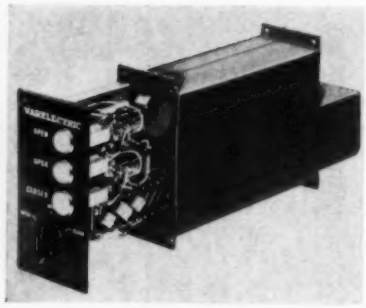


## Valve Operator Control

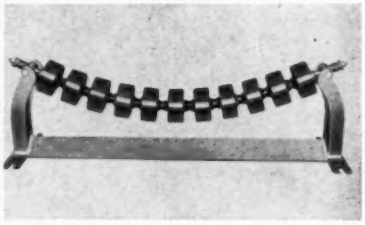
Two-wire supervisory control system provides direct, instantaneous control of pump motors, valve operators, and similar equipment. It continually supervises and indicates the status of the controlled device and uses only one wire between each control and field unit, plus one conductor common to many units. Principle of operation of the unit, designated Varelectric, involves the inherent polarization characteristics of a dc power source for remote control and the ability of a Wheatstone bridge circuit to recognize conditions and direction of unbalance. No power is required at the field end. Unit shown is Model 883-211. **Vapor Recovery Systems Co.**, 2820 N. Alameda St., Compton, Calif.

*Circle 450 on Page 19*

## Pneumatic Transducer

Adaptable for electronic control systems to eliminate freeze-ups caused by cold weather or low temperature fluids, transducer has a 30 w heater in the pneumatic section which prevents moisture in the air from freezing the mechanism. Model P2R is designed to work with a primary-element transmitter and controller-recorder. There are no vacuum tubes, journal bearings, or other friction surfaces. A magnetic force is opposed by an air-loading pressure to produce a pneumatic force linearly proportional to the electrical output of the controller. Unit is temperature compensated to maintain its calibration accuracy over a wide range of ambient temperatures. Electrical input range of the transducer is 1 to 5 ma; this produces an air output of from 3 to 15 psi. **Swartwout Div., Crane Co.**, Hooksett, N. H.

*Circle 451 on Page 19*



## Conveyor Carrier

Catenary conveyor carrier features a high tensile spring steel shaft to which is mounted a mild steel trunnion and a shock absorbing compression spring. This provides true catenary suspension for the conveyor belt under all load conditions. The shaft has an initial set providing a trough which enables rigid belts to make contact with the face of all rollers when the belt is running under all load conditions. Carrier is available for 18, 20, 24, 30, and 36-inch belt widths. **Standard Products Div., Stephens-Adamson Mfg. Co.**, Aurora, Ill.

*Circle 452 on Page 19*

## Rotating Transformer

Device is used in a system to provide controlled angular rotation in exact relation to the rotation of the shaft of the rotating transformer. It operates from an input of 1 phase 60 cycles and is capable of driving positioning motors at torques up to 1 lb-ft. The transformer can be driven at speeds from zero to 600 rpm, with the positioning motor following in exact relation to the

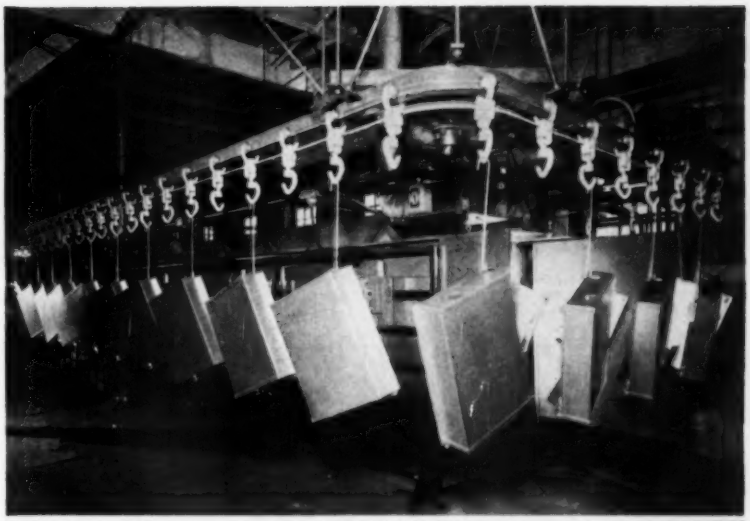
shaft speed for the transformer. There is no torque reaction between the positioning motor and the rotating transformer, so that less than 1 lb-in of torque to the transformer will provide torques up to 1 lb-ft from the positioning motor. **B. A. Wesche Electric Co.**, 9027 Shell Rd., Cincinnati 36, Ohio.

*Circle 453 on Page 19*

## Stepping Motor

Applicable as a power source for driving potentiometers, counters, rotary switches, tape advances, and indicators; stepping motor or indexing device is available in uni-directional or bi-directional models. Direct coupling of the shaft to load permits mounting of a position indicator on the shaft. Unit, designated Digimotor, is available with 8, 10, 12, 18, 20, and 24 steps per revolution, with or without detent. Stepping rate is 15 to 25 steps per second, depending on the number of positions, load, and other factors. Environmental specifications for the unit are: Vibration 10 g 2000 cps; shock 110 g, 6 millisecond ±1 millisecond; humidity 95 per cent relative; operating temperature −55 to +120 C. **Ledex Inc.**, 123 Webster St., Dayton 2, Ohio.

*Circle 454 on Page 19*

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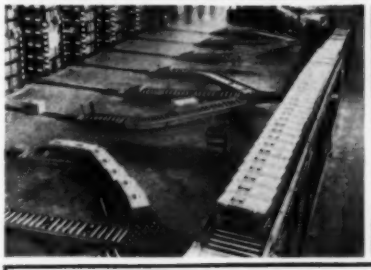

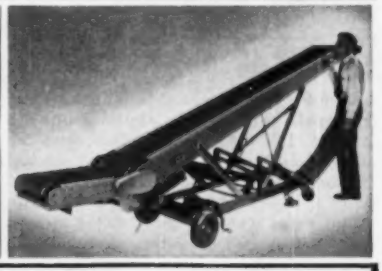

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*Circle 719 on Page 19*

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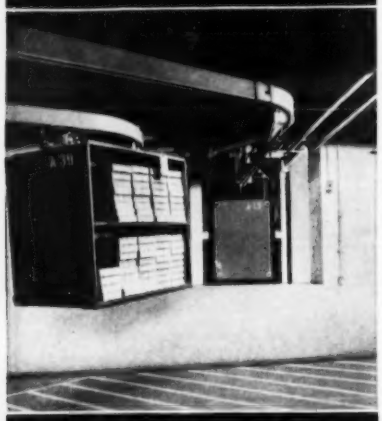

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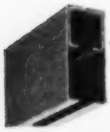
AUTOMATIC DISPATCH CONTROL

• *Simply set dials and Telematic guides carrier to any station in system*



POWER RAIL
FREE RAIL

Employs exclusive unitized "over and under" power and free rail which permits simple switching to right or left as desired.

**Power-Flex is designed for automated materials forwarding applications in industrial plants, distribution centers, service buildings and department stores. The most economical system available for loads up to 600 lbs. per carrier. Savings in actual installations range from 25% to 60%.**

*Systems in service for your inspection.

*Engineered to your very specific requirements.*

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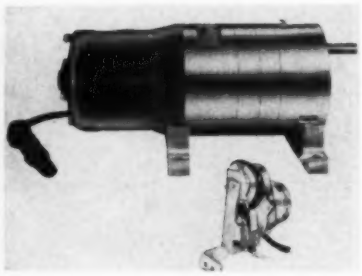
*Inquiries from your engineers or consultants welcomed.*

CM CONVEYORS
**COLUMBUS McKINNON CHAIN CORPORATION**
*Conveyor Division*
TONAWANDA, N. Y.

Circle 720 on Page 19

## Speed Detecting Governor

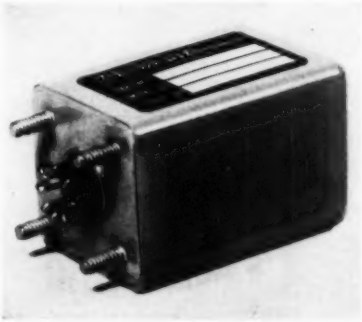
Capable of detecting low speeds below 100 rpm, centrifugal governor is applicable for the automatic shifting of machine tool transmissions, protection of low speed mixers, dryers, and similar processing equipment, and sequencing of conveyors and automated systems. Unit, designated Co-Rater also provides a method of automatically controlling drum speeds in computers. It can detect one or many low speed functions. A single, or a high and low limit can be detected on each speed. Each individual speed detector operates on speed alone, independently of voltage, load, or other environmental factors. It is frictionless in operation and provides a service life to 1,500,000 cycles. **Torq Engineered Products Inc.**, Bedford, Ohio.

Circle 455 on Page 19

## Indicating Transmitter

Line of pneumatic indicating transmitters is suitable for pressure, flow, temperature, liquid level, differential pressure, and dew point measurements. Transmitter is available with measuring elements in the following ranges: Pressure, 0-10 inches water to 0-80,000 psi; temperature, −450 to +1000 F (−270 to +500 C); flow, 0-1 to 0-400 inches water; liquid level, open vessels 0-10 inches water minimum, closed vessels 0-20 inches water minimum; dew point, 50 to 165 F; output signal, 3-15 psi. With Model 45 there is less than ½ per cent error for ambient temperature changes as great as 50 F, regardless of the variable measured. Overall calibrated accuracy of the transmitter, including measurement and output signal, is within ±½ per cent. **Foxboro Co.**, Foxboro, Mass.

Circle 456 on Page 19



## Frequency Monitor

Solid state frequency monitor provides indication and control of phenomena associated with varying frequency. Related functions, such as time delays for opening or closing contacts and activating warning or control devices, can be incorporated in the monitor. Other applications include use as direct frequency sensors, over or under speed indicators, and controllers. Instrument will operate within a frequency range of 400 cps to 10 kc at ±1 per cent accuracy. It has an input supply voltage of 28 v dc, with a minimum input signal of 900 mv. Temperature range is −55 to +125 C. **Voi-Shan Electronics**, Dept. FM3, 13259 Sherman Way, North Hollywood, Calif.

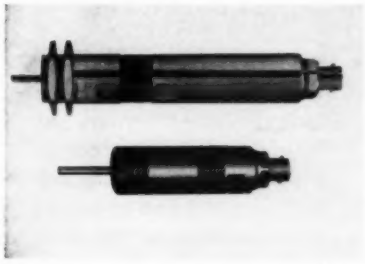
Circle 457 on Page 19

## Insert Valves

Cartridge type insert valves fit inside the pneumatic or hydraulic

devices (such as a cylinder or manifold) that they control. Type of models available include ⅛ and ¼-inch sizes, for 2-way or 3-way service that are actuated manually, mechanically, electrically, or by a pilot. Valves are quick-opening, positive dead-seal closing, and have built-in exhaust. They can be used for continuous cycling at speeds up to 30,000 per hour. **Humphrey Products Div., General Gas Light Co.,** Kalamazoo, Mich.

*Circle 458 on Page 19*



## Displacement Transducers

Devices are capable of measuring linear displacement between 0.500 and 2.000 inches with a frequency response from 0 to 10,000 cps, dependent on the measuring system. In operation, an electrical capacity is formed between an insulated tapered concentric cylinder of the transducer and the rod. An inductance is built into the body of the transducer to form a tuned radio frequency circuit. This circuit is link-coupled to an oscillator detector circuit. Small capacity changes between the rod and the tapered cylinder of the transducer body produce relatively large changes in the diode detector impedance. The voltage output of the

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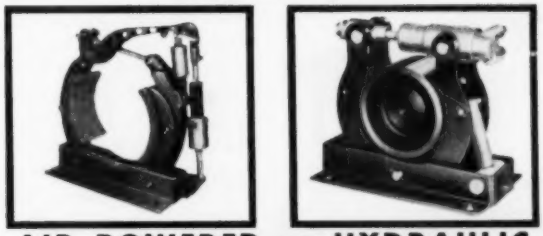
OFF THE SHELF
ELGIN ADVANCE RELAYS
300 DISTRIBUTORS STOCK
ADVANCE RELAYS
FOR EXAMPLE:
A COMPLETE LINE OF GENERAL PURPOSE (GH) RELAYS ARE AVAILABLE FROM STOCK
These new Advance GH midget relays are engineered for high efficiency and low cost. A tremendous variety of applications permits countless uses. The small size of these midgets allows their installation in equipment where space is a problem. GH relays are available in three open Series—GHA (5 ampere rating), GHB (10 ampere rating), GHS (5 ampere plate circuit type). Also in three dustite plastic enclosure Series—GHP (5 ampere rating), GHH (10 ampere rating), GHE (5 ampere plate circuit type). Enclosures are supplied with 8-pin octal for 1C and 2C, 11-pin for 3C.
FOR GH SERIES DATA USE NUMBER BELOW
ELGIN ADVANCE RELAYS
ELGIN-ADVANCE RELAYS ELGIN NATIONAL WATCH CO.
2435 N. NAOMI ST. / BURBANK / CALIFORNIA

*Circle 721 on Page 19*

# STOP EQUIPMENT SAFELY

with Wagner



**AIR POWERED or HYDRAULIC BRAKE SYSTEMS**

Wagner makes both air powered and hydraulic industrial braking systems that stop your equipment safely, easily, economically.

WAGNER AIR POWERED BRAKING SYSTEMS use the same heavy-duty brakes that Wagner builds for hydraulically operated overhead crane brakes. Application is flexible . . . any number of brakes and control points may be used at reasonable distances from each other.

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**Wagner Electric Corporation**

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*Circle 722 on Page 19*

FOR THE SYSTEMS OF THE SIXTIES

CONVEYORS THAT COST LESS TO INSTALL

*NEW* Series E Belt Conveyors are pre-engineered with standard components so you can save money by installing them yourself. These components are *also interchangeable* with those in other Unibilt® conveyors further simplifying system installation.

Exploded photo of UNIBILT® Series E Belt Conveyor

CONVEYORS THAT COST LESS TO OPERATE AND MAINTAIN

*NEW* Series EP Live Roll Conveyors feature automatically adjusted belt tension, eliminating the need for manual adjustment and conserving power. Unibilt assembly can easily be altered when handling requirements change.

UNIBILT® Series EP Live Roll Conveyor

UNIBILT® Conveyor System

Write for Unibilt Bulletin

CONVEYOR SPECIALTY CO.

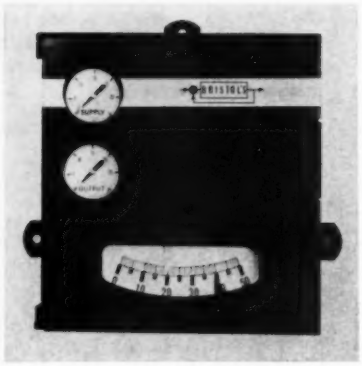
INCORPORATED

25 Newport Avenue, North Quincy, Mass.

Circle 723 on Page 19

detector provides an accurate measurement of the linear displacement of the moving object. **Photocon Research Products**, 421 N. Altadena Dr., Pasadena, Calif.

Circle 459 on Page 19



## Pneumatic Controller

Position-balance indicating controller (Model 624) is suitable for proportional control with 1 to 400 per cent proportional band, and reset control with 0.1 to 50 repeats per minute reset rate. It is applicable for control of pressure (full vacuum to 10,000 psi), temperature (−100 to 1000 F), flow and differential pressure (mercury and dry-type meter bodies), humidity (0 to 100 per cent RH), and differential liquid level. The frequency response curve is flat to 400 cpm (proportional) and 325 cpm (proportional plus reset). The ambient temperature stability is less than 0.1 per cent change in output pressure for 90 F temperature change. **Bristol Co.**, Waterbury, Conn.

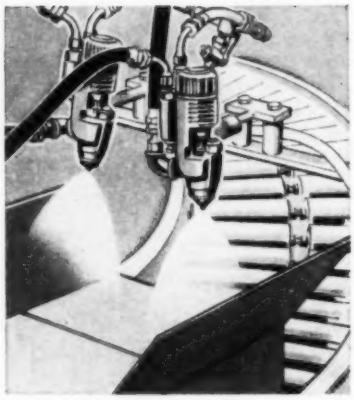
Circle 460 on Page 19

## Control Kit

Control kit is adaptable to numerous electrical measurable variables. Package consists of a continuous reading meter-relay and all the parts for assembling a control—transformer, load relay, capacitor, resistors, rectifiers, and terminal block. Control action of the continuous reading meter-relay is directly linked to the signal. In operation, an adjustable pointer sets the signal limit. When the indicat-

DeVilbiss spray guns apply almost anything that pours — automatically!

Gluing cartons



For applying adhesives, DeVilbiss automatic spray guns can be set to assure just the right coverage of carton flaps without waste. Guns are split second timed and synchronized for fully automatic packaging. This or similar automatic applications are ideally suited to the versatility and flexibility of DeVilbiss automatic guns. Call our nearest representative or write direct. The DeVilbiss Company, Toledo 1, Ohio. Branch offices in principal cities.

FOR TOTAL SERVICE, CALL

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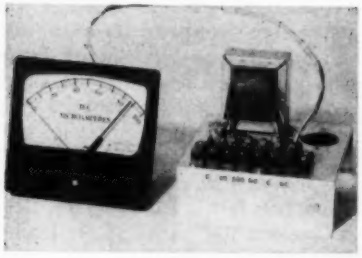
Circle 724 on Page 19

Circle 722 on Page 19





ing pointer reaches set point, it trips a toggle contact on the adjustable pointer. Control action either begins or ends, depending on whether the signal is rising or falling. The moving pointer shows the signal at all times, even when it passes set point and energizes control action. **Assembly Products Inc.**, Chesterland, Ohio.

Circle 461 on Page 19

## Pressure Switch

Designed for use in fuel, hydraulic, pneumatic, or refrigeration applications in temperatures ranging from −65 to 275 F, lightweight pressure switch is available for operation at any fixed pressure between 5 and 1000 psi. Adjustments of the operating point of the switch is accomplished by unlocking and turning the electrical receptacle. Contacts in the switch element are available as single-pole, double-throw, normally open; single-pole, single-throw, normally open; or single-pole, single-throw, normally closed. Contact ratings are, at 30 v dc, 2½ amp inductive or 5 amp resistive at 50,000 ft; at 125 or 250 v ac, 5 amp. **Consolidated Controls Corp.**, Bethel, Conn.

Circle 462 on Page 19

Baldor Motor specially-designed for the Southwestern Engineering Co., Los Angeles. This motor, with eccentric weight on both ends of shaft, is the drive mechanism for their efficient SWECO Vibro-Screen Separator.

Another version of same motor designed by Baldor to fit a specific application. Result is a highly efficient power-plant that keeps equipment operating with a minimum of downtime.

**Let BALDOR'S unique engineering service design the one right motor for your equipment!**

To assure maximum efficiency from today's highly complex and precision-built equipment, more than just a standard-type motor is needed to supply the power. It has to be designed and engineered to fit the specific application—not just *adapted* to the equipment.

Baldor's staff of extremely competent engineers has played an important part in helping many original equipment manufacturers develop motors that are "tailor-made" for their particular requirements.

This outstanding design and engineering service is yours without delay or obligation. Contact your local Baldor representative or write direct.

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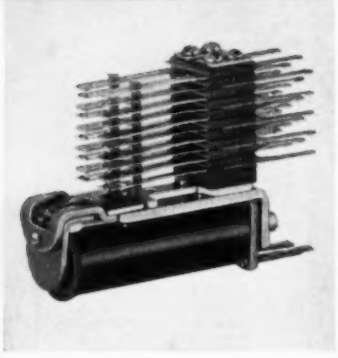
Circle 725 on Page 19

"Telephone Quality"
Stromberg-Carlson
RELAYS



**. . . featuring new high-voltage types for test equipment or other high-voltage applications.**

THE insulation in the new relays withstands 1500 volts A.C.—three times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

***Type A:*** *general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.*

***Type B:*** *a gang-type relay with up to 60 Form "A" spring combinations.*

***Type BB:*** *relay accommodates up to 100 Form "A" springs.*

***Type C:*** *two relays on the same frame. A "must" where space is at a premium.*

***Type E:*** *has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.*

Details on request. In Atlanta call TRINITY 5-7467; Chicago: STATE 2-4235; Kansas City: HARRISON 1-6618; Rochester: HUBBARD 2-2200; San Francisco: OXFORD 7-3630. Or write to Telecommunication Division, 111 Carlson Road, Rochester 3, New York.

STROMBERG-CARLSON
A DIVISION OF
GENERAL DYNAMICS

Circle 726 on Page 19

## Hydraulic Power Pump

Capable of driving rams, jacks, and presses, line of hydraulic power pumps has a pumping capacity of 150 cu in. per minute at pressures up to 150 psi and automatic changeover to 30 cu in. per minute up to 10,000 psi. It is powered by a self-contained ¾ hp, 115-230 v, ac single-phase, constant - speed (1725 rpm) capacitor-type electric motor. Usable oil volume is 260 cu in. The motor can be started under load, while the ram is held in position under pressure. The pump is furnished with an outlet block having two pipe outlets for pressure take-off and return. **Greenlee Tool Co.**, Rockford, Ill.

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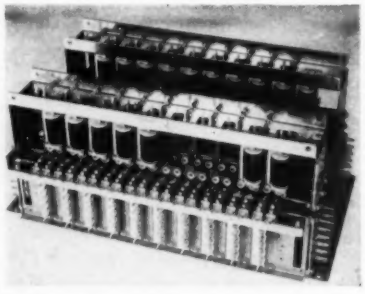

## Crossbar Switch

Suitable for video, audio, and sync switching, Model P can switch sequentially or at random up to 120 circuits. Individual magnets at each crosspoint make an electrical connection at the crosspoint, closing a circuit in one input and one output. Any circuit combination can be set up in any sequence with each circuit having up to six poles. The switch terminals accept AMP 78 taper tab connectors, connector plugs, or they can be soldered. Twin gold contacts carry 100 ma non-inductive load at 50 v dc for 20 million operations. A normal life per crosspoint is said to be in excess of 20 million operations without adjustments. **James Cunningham Son & Co. Inc.**, 104 Litchfield St., Rochester 8, N. Y.

Circle 464 on Page 19

## Punched Card Reader

Static card reader uses a standard IBM card to program operating, manufacturing, or blending cycles. The cards can be prepared on receipt of order and after the processing operation, forwarded to accounting department for record purposes. In operation, the card is inserted and remains in one fixed position, reading all 960 holes (80 columns of 12 holes each) simultaneously. Applications include: Power converting, power actuating, sensing, regulating, communicating, programming, computing, data converting, data storing, and data presenting. **Richardson Scale Co.**, Clifton, N. J.

Circle 465 on Page 19

## Wireways & Fittings

Line of flanged hinged-latched-cover wireways includes: *T* fittings and pull boxes, cross pull boxes; junction boxes; standard or adjustable nipples and telescope fittings for making odd length connections; trough collars for adding flanges to cut wireways; reducing bushings to permit mid-run reductions in wireway sizes, closing plates for sealing openings; plus drop hangers, bracket hangers, and collar gaskets. All units are fabricated of heavy gauge sheet steel with flanges seam welded

to the ends of each section to provide a liquid-tight seal. The wireways and fittings are available in four sizes, in lengths from 1 to 5 feet. **Keystone Mfg. Co.**, 23328 Sherwood Rd., Warren, Mich.

*Circle 466 on Page 19*

## Elapsed Time Controller

Instrument, when installed in the circuit of a batch type operation, will provide timed automatic regulation of either temperature or pressure. Model 7003 is furnished in types covering the complete range of Bourdon tube type temperature and pressure instruments. Charts and ranges are available as low as −100 F or 30 inches of mercury vacuum and as high as 1000 F or 7500 psig. A 12-inch circular chart is used to record all data. Either one or two pens are employed and timing is deferred until the pen approaches the control point.

In operation, the controller is activated by an external *Start* button and a red signal light indicates the start of the process. As the measured variable approaches the control point, the timed phase of the cycle begins, lighting a green signal light. When the preset timed period has elapsed, both lights go out, the controller automatically shuts down, and the timer resets and is ready for a repeat cycle. Time ranges available include: 60 minutes, 5 hours, 12 hours, or 24 hours; minimum setting of each timer is equal to 4 per cent of its range. **Weston Instruments Div., Daystrom Inc.**, 614 Frelinghuysen Ave., Newark 12, N. J.

*Circle 467 on Page 19*


**POST ELECTRONIC PRODUCTS**

Keeps tabs on hourly production *and* count . . . tool

MODEL P2 RM

The Post P2 RM is a preset electronic counter which **also indicates hourly production rate** on a two-scale rate meter. By using this dependable component in conjunction with sheet fed machines, conveyor lines, small parts manufacturing, etc., you have the benefit of "batch" counting desired quantities. At the same time you'll be able to keep tabs on your production flow. A visual totalizer indicates unit or total batch counts.

*For complete details write:* Decitron

**POST ELECTRONIC PRODUCTS**

*Division of Reid Brothers Company, Inc.*

12 LOTHROP ST / BEVERLY, MASS.

*Circle 727 on Page 19*

**MOLINE**

No. HD68 Special

Multiple-Spindle Machine with 81" clearance between columns, drills, reams and chamfers holes in tube sheets of various sizes. Electric control provides means for determining hole pattern through selection of in-line spindles and control of two-way, positive-positioned hydraulic indexing work table.

*For Greater*

**PRODUCTION • EFFICIENCY • SAVINGS**

Use an individually designed "Hole-Hog" Machine Tool for such jobs as:

- Multi-Spindle Boring
- Single and Multi-Spindle Honing
- Straight Line Multi-Drilling
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- Vertical and Way-Type Fixed Center Drilling, Boring and Tapping
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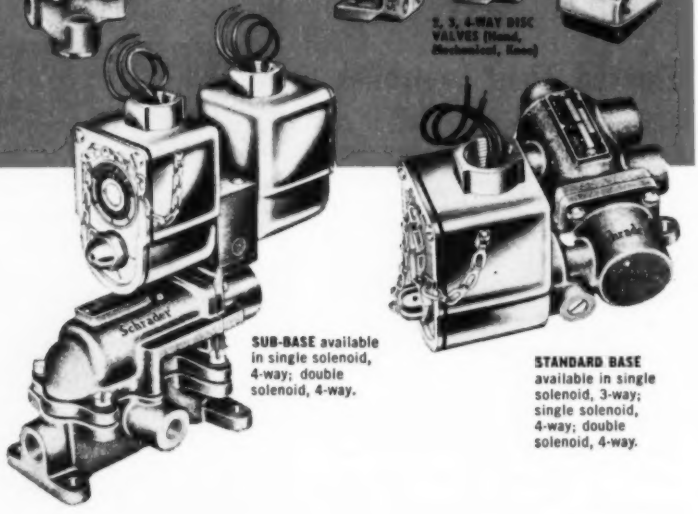
*Circle 728 on Page 19*

# SELECT FROM SCHRADER'S FULL LINES...

2 and 3-WAY VALVES (Roller Lever)
2 and 3-WAY VALVES (Angle Lever)
2 and 3-WAY VALVES (Hand Lever)
2 and 3-WAY VALVES (Hand Lockdown)
3-WAY SINGLE SOLENOID VALVES
4-WAY DOUBLE OR SINGLE SOLENOID VALVES (Sub Base)
4-WAY VALVES (Hand, Lockdown)
4-WAY STANDARD OR SUB BASE VALVES (Pilot Operated)
4-WAY DOUBLE OR SINGLE SOLENOID VALVES (Standard)
DISC VALVES—PIPED EXHAUST TYPE (Hand, or Mechanical Operated)
4-WAY VALVES (Foot, Lockdown)
2 and 3-WAY PILOT VALVES (Timed or Fixed, Normally Open or Normally Closed)
2, 3, 4-WAY DISC VALVES (Hand, Mechanical, Knee)
4-WAY VALVES (Foot, Spring Return)
NEW DELAYED BLAST VALVE



**SUB-BASE** available in single solenoid, 4-way; double solenoid, 4-way.

**STANDARD BASE** available in single solenoid, 3-way; single solenoid, 4-way; double solenoid, 4-way.

## ...TO IMPROVE PERFORMANCE OF ANY OPERATION

## ...TO UPGRADE PRODUCTION

New JIC Solenoid Valves are compact, rugged, fast-and-easy to install. Roomy junction boxes fit space requirements with 90° rotation. Can be operated in case of current failure, by hand. Safe, recessed override button prevents accidental operation. Electrical system completely sealed against dust, oil.

Schrader's complete line of air valves allow you a freer hand in planning air circuits for your applications. Besides almost unlimited choice of size, style and actuation method, you get these extras in every Schrader valve you buy:

- All parts are designed for maximum air flow, longest service life; simplicity of replacement; interchangeability.
- Schrader Valves feature tough, practical design, precision construction, and are individually tested to full ratings.
- Performance has been proved by years of use in hundreds of plants. All Schrader Valves can operate with Schrader (JIC) Square End Cylinders perfectly.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

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*Division of Scovill Manufacturing Company, Incorporated*
**472 Vanderbilt Avenue, Brooklyn 38, N. Y.**

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QUALITY AIR CONTROL PRODUCTS



Circle 729 on Page 19

AUTOMATION

# catalogs and literature

**Latest automation information. For copies use card on page 19.**

## Tension Controls

*Web Controls Corp., 318 Briarcliffe Rd., West Englewood, N. J.—6 page pamphlet*—Bulletin describes tension and torque controls for webs and filaments and general motion and servo motor controls. The automatic tension control units described provide instantaneous response and adjustment for the control of webs and filaments on winding or unwinding equipment. The torque control unit is designed for spooling, remote actuation, servo control, speed, and process control.

**Circle 468 on Page 19**

## Sheeting Equipment

*Automation Div., F. J. Littell Machine Co., 4101 N. Ravenswood Ave., Chicago 13, Ill.—12 page booklet*—Line of sheeting equipment covered in Bulletin G-10 can convert large coils into flat blanks. It can handle steel stock as thick as 0.020 inch as well as material as thin as 0.0055 inch. Individual units in the sheeting line described include: Sorters and stackers, roll feed and cut-off machine, operator's console, inspection section, straightening machine, and spindle reel and coil loading car.

**Circle 469 on Page 19**

## Air and Lift Tables

*Clark-Aiken Co., Lee, Mass.—4 page pamphlet*—Air tables to move loads and hydraulic tables to lift loads are outlined in pamphlet. They are applicable in the handling of paper, film, foil, and board packs. Schematic drawings show installations using both types of tables. Notes are also given on finishing room equipment such as roll stands, cutters, and pilers.

**Circle 470 on Page 19**

## Worm Gear Speed Reducers

*Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.—66 page catalog*—Line of fan-cooled worm gear speed reducers is described in Book 2824. Data are given on 25 types and over 135 sizes in ratios ranging from 5:1 to 3600:1, with torque ratings up to 135,000 lb-in., and horsepower ratings up to 150. Thermal input and mechanical output torques are shown for every speed and ratio for each reducer size. Rating tables are arranged according to speed as compared to ratio.

**Circle 471 on Page 19**

## Snap-Lock Limit Switch

*National Acme Co., 170 E. 131st St., Cleveland 8, Ohio—16 page booklet*—Subject of Bulletin EC-SL260 is a snap-lock limit switch (Model SL-2) that has a 67 degree over-travel, 90 degree bypass, and 180 dgree total operating arc. Details are given on the workings of the snap-lock mechanism and the actuating cam mechanism. Dimensional drawings show the specifications, and other sketches show the various operating levers available.

**Circle 472 on Page 19**

## Welder Transformers

*Taylor Winfield Corp., Warren, Ohio—20 page booklet*—Transformers, the heart of resistance welding machines, are discussed in Bulletin SP-23. Points covered include: Construction techniques, transformer rating and load demand, magnetizing and load transients. Formulae are given for calculating kva loading at various duty cycles, with consideration of series parallel windings and eight step windings. Illustrations show the transformer under construction.

**Circle 473 on Page 19**

## Recording Instrument

*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.—4 page pamphlet*—Data sheet NY2(1) entitled "Speedomax H Range Conversion" provides a guide to selecting the necessary components (scale, chart, and circuit panel) to change the range of any standard Speedomax H instrument. A master table lists the basic items required to change the range for the same type of primary element or from one type of primary element to another.

**Circle 474 on Page 19**

## Vacuum Filter

*Commercial Filters Corp., 2 Main St., Melrose 76, Mass.—4 page pamphlet*—Subject of Bulletin DP-114 is Filter-Matic, an automatic self-cleaning vacuum filter, applicable in functions where heavy contamination in liquid-solid separation presents a problem. Features are pointed out, and schematic diagrams show the filtering and the backwash cycles of the unit which can handle flow rates up to 1000 gpm.

**Circle 475 on Page 19**

## Gas Chromatographs

*Process Instruments Div., Beckman Instruments Inc., 2500 Fullerton Rd., Fullerton, Calif.—12 page booklet*—Industrial gas chromatographs, used for stream analysis in chemical plants, refineries, and other process industries, are described in Bulletin GC-4018. Principle of operation is explained, and construction and performance features are noted. Also included are flow diagrams of the analyzer, of a typical plant installation, and of a temperature control system.

**Circle 476 on Page 19**

## Conductor Bar Systems

*Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio—4 page pamphlet*—Conductor bars described in Bulletin 2016-D provide safe electrification on overhead materials handling equipment, preventing workers from coming in accidental contact with power bars. Construction details are given and the safety features explained. Illustrations show the different types of conductor bars available.

**Circle 477 on Page 19**

## Form Grinder

*Sheffield Corp., Dayton 1, Ohio—10 page bulletin*—Subject of Bulletin FG-181-260 is a machine for grinding annular forms and grooves in workpieces up to 10 inches in diameter and 24 inches between centers. Model 181 is available with automatic part handling, size control and gaging, as

well as wheel compensation and dressing. Details are given on the Crushtrue grinding wheel dressing process which grinds multiple diameters, or forms up to 4 inches wide, in one operation with single or multiple wheels.

Circle 478 on Page 19

## Ladle Additions Feeder

*Equipment Div., Blaw-Knox Co., Box 1198, 300 Sixth Ave., Pittsburgh 30, Pa.—8 page bulletin*—Subject of Bulletin 2578 is a ladle additions feeder, an apparatus for adding solid materials to molten metal as the metal is poured into a ladle. It is a device made up of a feeder hopper with a feeder pan below, a means for vibrating the feeder pan, and a discharge chute. The three-step process of loading, positioning, and controlled feeding used with the units is explained. Details are given on the types of feeders and mountings available. Vibrating and weighing controls are also reviewed.

Circle 479 on Page 19

## Lifts and Lift Tables

*American Mfg. Co. Inc., 2119 Pacific Ave., Tacoma, Wash.—8 page bulletin*—Line of hydraulic scissor lifts and pantograph lift tables are covered in Bulletin AMC-1300. Lifts are available in capacity ranges from 1000 to 24,000 lb, with travels of 24 to 60 inches. The standard features and safety features are pointed out, and notes are given on optional equipment.

Circle 480 on Page 19

## Pendent Switches

*Electrical Products Div., Joy Mfg. Co., 1201 Macklind Ave., St. Louis 10, Mo.—8 page bulletin*—Rubber-encased pendent switches for electric hoist control are described in Bulletin 79. Front, back, and an interior view of the station show the switch well, water seals, and the limit switches in proper position. Safety and maintenance features are brought out, and data are also given on toggle and other types of molded-to-cable switches.

Circle 481 on Page 19

## Welding Process Equipment

*Air Reduction Sales Co., Div., Air Reduction Co. Inc., 150 E. 42nd St., New York 17, N. Y.—24 page catalog*—Automatic, semi-automatic, and manual tungsten-inert-gas welding process equipment is described in Catalog ADC 709G. Data are given on accessory equipment, tungsten electrodes, and filler wires used in conjunction with this welding process. Details are also included on two automatic heads for long run production applications.

Circle 482 on Page 19

## Dust Control

*Dracco Div., Fuller Co., Harvard Ave. & E. 116th St., Cleveland 5, Ohio—12 page booklet*—Booklet 806 entitled "Freedom from Hot, Corrosive Dust with Glass-Bag Filters" is a report which describes how glass-bag filters are applicable in cleaning hot, corrosive gases in three plants representative of the cement and metallurgical industries. Temperature of gases filtered in one of the installations reaches 550 F, just 50F under the maximum temperature capacity of the filters. Notes are given on two methods of cleaning glass fabric bags.

Circle 483 on Page 19

## Recorders

*U. S. Gauge Div., American Machine & Metals Inc., Sellersville, Pa.—8 page bulletin*—Line of temperature and pressure recorders is described in Catalog 800. Temperature elements described include the following types of actuation: Mercury, vapor pressure, gas pressure, and organic liquid. Photos show mechanical construction features such as movement, pen arm, pens, chart drives, access plates, and a bellows element in position in the recorder. Diagrams show case dimensions and details of pressure and temperature connections.

Circle 484 on Page 19

## Phenolic Molding Materials

*Union Carbide Plastics Co., 30 East 42nd St., New York 17, N. Y.—6 page pamphlet*—Bulletin 40 is a report covering two Bakelite Brand phenolic molding materials. BMM-7001 is a dust and fines free material designed for fast, powder automatic molding, either cold or R.F. preheated. BMM-7002 is supplied in Stokes granulation for plunger molding with high frequency preheat. The maximum preform temperature of both materials is about 295F. Tables list physical properties, and graphs show minimum cure plunger mold, preheating rate, and range of plunger mold fill out.

Circle 485 on Page 19

## Motion Indicator

*Bin-Dicator Co., 13946 Kercheval Ave., Detroit 15, Mich.—4 page pamphlet*—Subject of Bulletin RG-21 is Roto-Guard, a positive motion indicator safety mechanism designed to convert rotary motion into an electrical signal. The signal impulse is then used to energize an alarm system or to operate control switches automatically. Sketches show how the control is used in applications in the process industry.

Circle 486 on Page 19

## Data Printing

*Teletype Corp., Dept. SP-9, 4100 Fullerton Ave., Chicago 39, Ill.—20 page booklet*—Data are contained in booklet on stunt box control device designed for use with company's Model 28 Teletype page printers and automatic send-receive sets. Some of the functions of the stunt box described in the booklet include: Mechanically initiating internal functions within the typing unit of the page printer set, electrically controlling functions within the page printer set, and electrically controlling external equipment.

Circle 487 on Page 19

## Temperature Controls

*Assembly Products Inc., Chesterland, Ohio—12 page booklet*—Control packages, designed to provide accurate temperature control for kilns, ovens, furnaces, and general industrial processes, are described in Bulletin 108. Data are given on three basic types of thermocouple-actuated Simplytrols, including a proportioning model that is capable of holding temperature to ±1F of set point. Ordering instructions are given, as are notes on the accessory equipment.

Circle 488 on Page 19

## Conveyor-Scale Systems

*Weighing & Control Components Inc., 773 E. County Line Rd., Hatboro 10, Pa.—4 page pamphlet*—Details are given in Bulletin 60 on the use of conveyor-scale systems for flow-rate control and total through-put measurement of bulk materials. It discusses the systems that are used in conjunction with flat-bed or trough-type conveyor-line systems, fixed or variable speed, to provide in-motion weight measurement. Another point covered is the application of conveyor-scale systems to a variety of control functions in processing and formulating operations, including ingredient proportioning.

Circle 489 on Page 19

## Electrical Signaling Equipment

*Sperti Faraday Inc., Adrian, Mich.—88 page catalog*—Data are contained in Catalog 160 on line of air and electric signal equipment used for fire, burglar, and general alarm; for starting-dismissal signaling; as trouble indicators; for code paging; and for scheduling. Included in the line of equipment are light duty signals such as bells and buzzers and heavy duty signals such as horns, trumpets, chimes, and sirens. Visual indication signals such as annunciators are also covered. Notes are given on the two available types: Gravity drop or lamp style.

Circle 490 on Page 19

## Electronic Transformers

*Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.—36 page catalog*—Data are contained in Catalog TR-61 on line of electronic transformers that are applicable for audio, pulse, and transistor use. Included in the line are low-level audio transformers, isolation transformers, combined plate and filament transformers, filter reactors, audio transistor transformers, toroids, pulse transformers, geoformers, instrument power supply transformers, stepdown autoformers, chokes, and filament transformers.

Circle 491 on Page 19

## Tape Controlled Machinery

*Lahr Machine & Tool Corp., 3400 Maplewood Ave., Toledo 10, Ohio—4 page pamphlet*—Four tape-controlled drilling machines are outlined. This includes a heavy-duty single column turret drilling machine; a six-spindle planer-type turret drilling machine, a planer-type vertical drilling machine with automatic tool changer; and a quill-type drilling machine

with twin tilting tables. Dimensional diagrams on the units are included.

Circle 492 on Page 19

## Thin-Sectioned Ball Bearings

*Kaydon Engineering Corp., McCracken St., Muskegon, Mich.—28 page catalog*—Methods are described in Bulletin S-112R for applying thin-sectioned large bore ball bearings to equipment ranging in size from wire twisting machines to paper-making machine press rolls. Data are given on 90 sizes in six series of bearings. Numerous sketches show how the bearing is used on transmissions, machine tools, manufacturing and assembly machines, control equipment, instrument mounts, and clutches.

Circle 493 on Page 19

## Heating and Cooling Controls

*Powers Regulator Co., 3434 Oakton St., Skokie, Ill.—46 page catalog*—Data are given on automatic heating and cooling controls. Application drawings show control for domestic hot water heaters, fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, storage heaters, and two temperature hot water systems. Descriptions of the control operation are given.

Circle 494 on Page 19

## Electronic Computer System

*Computer Dept., General Electric Co., 13430 N. Black Canyon Highway, Phoenix, Ariz.—12 page booklet*—Electronic data processing computer system, described in Bulletin CPB-81P, employs magnetic character recognition, building-block design, and complete transistorization. It is explained how the system is advantageous to both large and small organizations. Services of the GE Computer Dept. are also listed.

Circle 495 on Page 19

## Digital Instruments

*Non-Linear Systems Inc., Del Mar, Calif.—20 page booklet*—Transistorized digital voltmeters, ratiometers, and ohmmeters are described in Bulletin 20-1. This includes a multipurpose instrument for measuring dc voltage, voltage ratio, and resistance; a volt-ratiometer for measuring dc voltage and voltage ratio; and a ratiometer for measuring dc voltage only. Principle of operation is explained, as is the conversion to ac and low-level dc measurements. Wiring diagrams and diagrams for output-input connections are given.

Circle 496 on Page 19

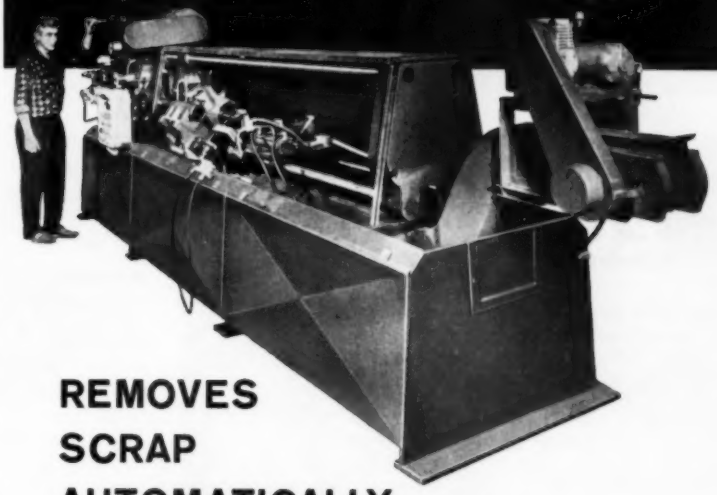
## Injection Molding Machines

*Hydraulic Press Mfg. Co., Div., Koehring Co., Mount Gilead, Ohio—6 page pamphlet*—Data are given in Bulletin 5831 on preplasticizing injection molding machines up to 300-ounces capacity with 1500-tons clamping pressure. A new design concept in preplasticizing of plastics material in injection molding is discussed, and illustrations of machines and parts being molded are shown.

Circle 497 on Page 19


MAY-FRAN CHIP-TOTE

PROVIDES ADDED VERSATILITY FOR HILL DRILL



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When continuous high-speed metal working operations mean the difference of profit or loss . . . the May-Fran CHIP-TOTE stands ready to remove scrap efficiently and automatically.

In the photograph above, the HILL-DRILL (a product of Walter P. Hill Inc.) is shown equipped with a May-Fran CHIP-TOTE. This accessory unit was fabricated into the machine prior to delivery to customer. Every day, more and more machine tool manufacturers are specifying the CHIP-TOTE to provide their automatic machines with virtually unlimited production without need for shut-down for scrap removal.

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Circle 730 on Page 19

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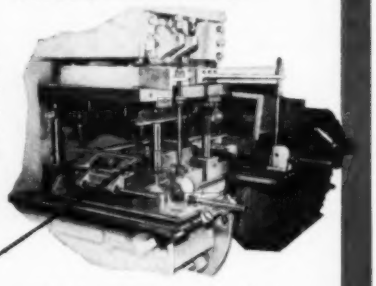
Die changeover is quickly made. Economical even for low volume production on new or existing equipment.



Press application of small 3-station line transfer unit shown.

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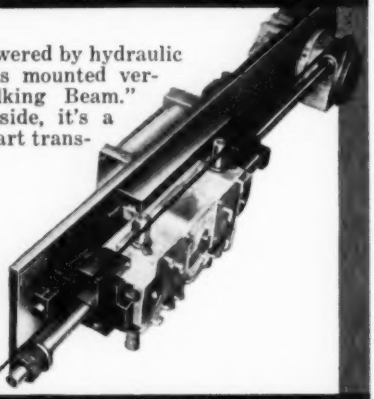

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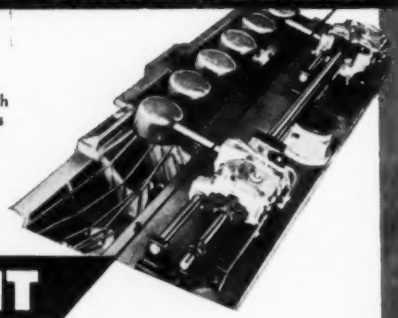

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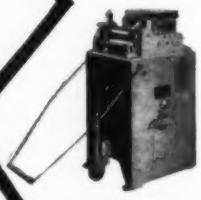

Models 308 and 312 for stock 1" to 12" wide, .018" to .065" thick.

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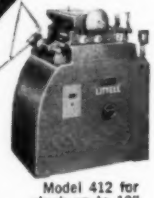

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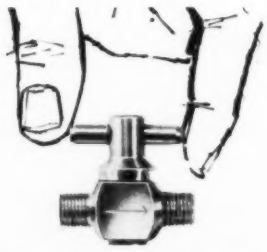

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Circle 733 on Page 19

# AUTOMATION abstracts

## ORDER SORTING AUTOMATED

BY R. L. SPEAKER
President
Speaker Sortation Systems Inc.
Milwaukee, Wis.

A NEW piece of equipment has been developed to fill the need for automatic sorting of packages in large distribution centers. This equipment was designed for and is installed in a general merchandise mail order distribution center. However, the principle should be applicable wherever large scale sorting problems are encountered such as in post offices, railway baggage terminals, airline terminals, transfer warehouses, military supply depots, equipment supply depots, and manufacturing operations involving supply of components to various assembly points.

Most large mail order houses operate on what is called the bulk picking principle. This principle is based on the fact that by grouping orders into large combinations the picking density is increased, thus cutting down on the number of personnel required to pick all the items for these orders. It has been found economical to add a large number of people to sort these grouped orders into individual orders because an even larger number of people can be eliminated in the picking area. With the new sortation equipment we are able to retain the efficiency in the picking department without adding additional personnel for sorting.

In the operation at General Merchandise Co. in Milwaukee, orders are prepared by an IBM 650 computer in groups of 400 orders. A group of orders is processed every fifteen minutes at the peak period of the year. Picking tickets are arranged in stock number sequence and forwarded to the stock pickers for each group of 400 orders. Each stock picker selects merchandise from a relatively small bin area. He attaches a picking ticket to each item of merchandise to indicate the ultimate individual order and makes a simple primary 4-way sort by loading the packages on one of four picking belts. Each belt thus receives merchandise for 100 of the orders in each group.

These belts carry the merchandise to the sorting conveyors for sorting directly into individual orders. The sorting installation consists of two rectangular loops with each short end of the loops having a loading point, thereby providing four loading points. Each of the four picking belts delivers merchandise to one of the loading points. Each loading point, therefore, handles all the packages for 100 orders at a time.

Each sorting loop is essentially an elongated carrousel chain conveyor consisting of a free hanging chain driven at one end of the loop by a large diameter drive sprocket and pulling a series of 4-wheeled carriages along a track. The chain is attached to the carriages by pins which permit the chain to hang suspended under the carriages, engaging nothing except the teeth of the drive sprocket and the take-up sheave at the far end. This construction permits very high speeds to be achieved without mechanical difficulties. Speed is only limited by the velocity capacity of the carriage wheels, and speeds up to 300 to 500 fpm are practical if necessary.

The top of each carriage is a slightly dished hori-

Operator is shown at one of four keyboard stations used to control four automatic sorting lines in a mail order house installation. Coded units of merchandise pass the operator on tiltable trays and are automatically dumped into order tote pans key selected by the operator.

zontal tray surface of a size suitable for the range of commodities being handled. This tray is normally locked in a horizontal position as the carriage travels down the conveyor, but is arranged so that it can be unlocked and tilted at right angles to the direction of travel when desired. This unlocking and tilting is performed by lever arms which are normally retracted out of the path of the carriage, but one of them is brought into the path of the carriage upon a signal from the electronic memory device whenever tilting of the tray at a predetermined point is required. The locking and tilting mechanism of this tray is arranged to selectively tilt to either side.

As the units of merchandise arrive on a belt from the picking areas, they are manually loaded one package per tray on the sorting conveyor in such a manner that the order number on the picking ticket is visible to a coding operator. As these packages pass the operator at a rate of 60 per minute, she reads the 4-digit typewritten number and inserts it into her keyboard. These packages are traveling past her at a speed of 180 fpm and she is able to read this 4-digit typewritten number without difficulty. These girls work 2 hours on, 2 hours off, and during the off periods are doing other clerical work in the accounting department.

The 4-digit number inserted into the keyboard is immediately transferred to a primary thyratron memory section in the controller. It is momentarily held there until triggered at an exact instant into a secondary neon storage area of the controller. This arrangement permits the operator to key in the number at any instant during the second that the tray is passing her but still provides an exact starting time for the tray so that the controller can measure the travel of the tray to its destination point very accurately.

As this would indicate, the controller is based on the impulse analog theory. An analog mechanism in the controller, driven at a speed corresponding with the conveyor speed, keeps track of the progress of each tray and matches this progress with the destination information which is stored in the memory unit from the keyboard. When the information from the keyboard matches the location of the tray, an impulse is sent from the controller to the solenoid actuating the tilting mechanism at that point and causing the tray to dump its package. The empty trays are later returned to the horizontal locked position by a simple mechanical cam.

To sort 100 orders on each leg of the loop, 102 empty tote pans are moved into position along one side of this leg. These tote pans are stored in an overhead conveyor storage area and are moved into position and out of position by means of power conveyors. The tote pans are each 36 inches long and butt against each other. Consequently, each leg of the loop is approximately 350 feet long including loading areas and sprockets.

There is an identical row of 102 tote pans located on the opposite side of the leg of the loop. Here is where the double tilting principle comes into operation. During a first 15-minute period in which 100 orders are being sorted on one leg of the loop, all of the trays dump packages into the tote pans on one side of the leg.

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SURE, CLEVELAND VIBRATOR CONVEYORS MOVE MOST ANY GRANULAR MATERIALS!
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At the end of this period these orders are completed. Within 30 seconds the system is ready to begin processing a second group of 100 orders by reversing a switch on the controller. All of the pans begin to dump to the opposite side into the empty tote pans arranged there.

Meanwhile, tote pans filled in the first period begin to move out of the sorting area on conveyors, and a new set of empty tote pans is moved in to take their place. These pans then are ready to receive merchandise for the third period a few minutes later. This flexibility permits a high degree of productivity from the equipment. If a cycling procedure of this nature were not required the controller could be arranged to permit discharge of any tray to either side, thus giving twice the number of sorts for a given length of conveyor, or conversely, half the length of conveyor for the same number of sorts.

Each row of pans contains two error dump pans in addition to 100 order pans. The first pan in the row collects items which were incorrectly keyed or not keyed at all. The last pan in the row collects any packages which might not have dropped correctly for reasons of malfunction of the equipment.

*From a talk presented at a meeting of the Association of Professional Materials Handling Consultants, Cleveland, January,* 1960.

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## AUTOMATION— CONCEPT AND OBSTACLES

By H. A. STRICKLAND Jr.
Vice President and General Manager
Industrial Electronics Div.
General Electric Co.
New York, N. Y.

IF PROPER and intelligent effort is put forth, I believe the advance of automation is inevitable because it is one of the potent and available tools which can spur the economies of our Western nations and thereby help us in our struggle to keep the world free. We cannot afford to haggle over whether we will or will not use any tool which is compatible with our free enterprise system and which may well be a deciding factor in the East-West economic duel. We in the United States no longer have the choice of weapons; we must exploit all the weapons in our economic arsenal.

Perhaps we should say that: "Automation is the concept of organizing and utilizing energy, machine elements, and information handling and control techniques to accomplish physical and mental work with less human effort; and to extend human capabilities."

Automation, then, is a concept; it is not a product (although products are employed in its implementation). In the United States, automation has been a significant factor in our economic growth and in the attainment of high personal living standards. In fact, our recent concern over the completion of the Soviet Union, Western Europe, and Japan stems largely from the narrowing automation gap between them and us. They have recognized and are applying automation techniques as rapidly as possible, and the resulting

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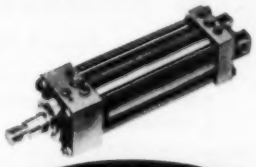

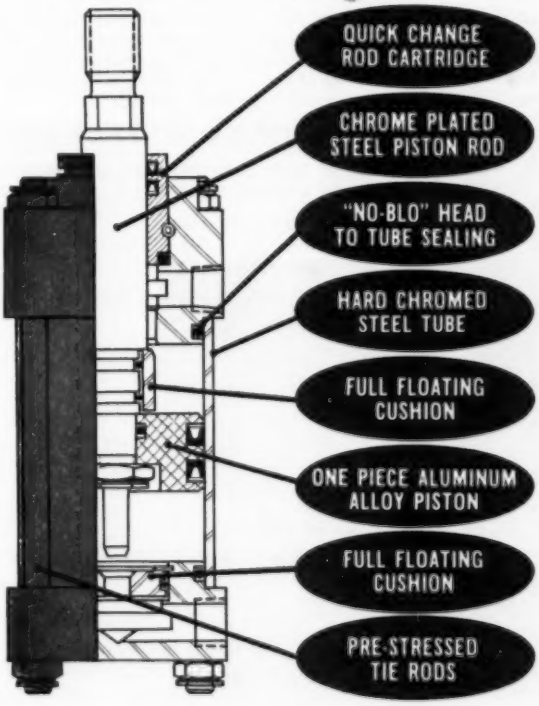
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Circle 735 on Page 19

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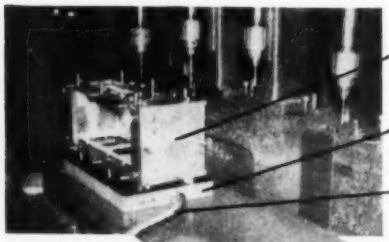
*Circle 736 on Page 19*

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*Circle 737 on Page 19*

impact is already evident.

Automation has contributed to our economic growth not only through increasing output, but by making possible whole new industries. Without automation such new industries as atomic power and rocketry would not exist since speeds, temperatures, and hazards involved are too extreme for human capabilities. Automation, then, has not only provided us with a greater output of traditional goods and services, but has made it possible for us to have goods and services we could not otherwise have.

The new aspect of the automation concept lies largely in its ability to acquire and handle information rapidly and cheaply. We have moved the decimal point several places to the left in the cost of applying programmed logic and in communicating. We have substantially increased servo and sensor competences.

These new aspects of information handling concepts and tools, in theory, now enable us to totally integrate mechanization. We can now harness measurement to automatic control devices and to the complex logic of computers and thence to mechanical muscles of power driven machinery. Or, we can harness an information system to the ingredients of a business.

We can start with a description of a customer need, select or design its solution, check the warehouse for parts or stock, issue instructions to programmed machine tools, assemble the product, check out its performance, issue shipping and billing documents, and pay the employees—all automatically.

Of course, in practice, we have not yet combined all of these operations for a single business—but we will. And the main reason we haven't done it yet is because we don't understand the business well enough—not because we lack the technology.

### Some Roadblocks

The progress of automation must, I believe, be inevitable, but there are roadblocks, both physical and psychological, which must be removed before optimum economic gain can be realized.

First, we lack sufficient knowledge and understanding of many production and management processes. We cannot automate what we do not understand.

Many processes and operations are still "art" rather than science. Many potential automation users do not really know what occurs between the operating input and output.

In many instances we who are considering automating do not have a clear understanding of our objectives. If an entire business is to be automated, objectives must be defined and the whole business rethought—the products themselves and product relationships, the market, and the distribution methods.

It is frequently a mistake to attempt to automate what is currently being done. The sewing machine, the centrifugal pump, and the rotary saw were possible only after the purpose of the operation and the desired result were determined. It proved impractical to try to mechanize the older manual methods directly.

Second, the economic feasibility in many applications has not been proved. Our technical ability to automate exceeds our ability to prove economic feasibility. We must, therefore, convert technical solutions to economic solutions. This points up an entrepreneurial

opportunity to today's manager: To both recognize the opportunity and risk his resources to assure substantial progress of automation.

Opportunities for automation are extensive, but we must prove the value of broader application. This is a kind of bootstrap-lifting process for the chances are that we don't know the cost of the present methods either. We may also have to adjust our accounting methods—for instance, applying overhead as a percentage to direct labor has no significance in many highly automated operations.

Third, the problem of personnel training and retraining must be solved. We must assure a work force competent to implement new operating methods and techniques. This will involve re-training programs for some of those in our current work force and appropriate changes in our educational systems to properly train the next generation to meet the new needs of society and industry.

Fourth, a concerted effort is needed to help people overcome their traditional psychological resistance to change and fear of the new. This general resistance to change has been fortified by our belief that continued economic growth, higher living standards, and free world survival are inevitable. We must recognize the fact that our industrial and economic superiority can no longer be taken for granted. Just as generations before us have met their problems and their challenges through ingenious application of available knowledge, coupled with unending efforts to expand that knowledge, so shall we.

There are definite roadblocks to the rapid achievement of wide application of the automation concept, but I see them as challenges not as immovable obstacles. I can only say: "It takes a lot of hard work and sacrifice by a lot of people to bring about the inevitable."

*From a talk entitled "The Inevitability of Automation," presented at the Fourth Conference on Manufacturing Automation co-sponsored by Purdue University,* AUTOMATION, *and Manufacturing Engineering Council, Lafayette, Ind., April,* 1960.

## NEW EQUIPMENT— LEASE, RENT, OR PURCHASE?

By R. W. PUDER and W. R. HILTON
Engineering Service Div.
Engineering Dept.
E. I. du Pont de Nemours & Co. Inc.
Wilmington, Del.

AVAILABILITY of lease and rental arrangements has expanded in recent years to the point that practically any type of equipment or facility can be acquired by these means. The only effort required on the part of the lessor is that he shop around for and set realistic specifications for the facilities desired.

Rental or lease type contracts are useful tools which are widely used in the materials handling, packaging, and distribution fields to acquire new equipment. In talking about materials handling equipment, we are concerned not only with lift trucks, conveyors, elevators, storage racks, and the like, but also packaging machinery, transportation equipment, warehouse build-

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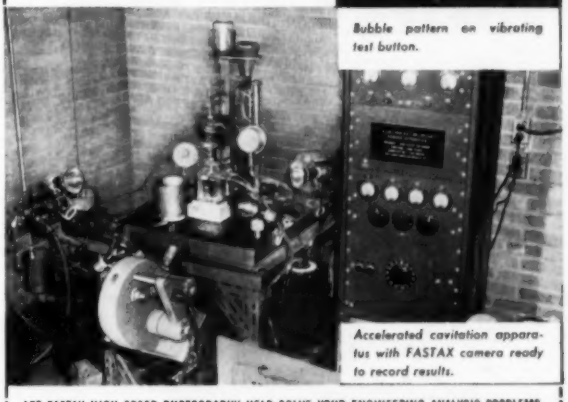

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ings, and facilities of all types. These are all components that need to be engineered into a suitable materials handling or distribution system. Our comments apply equally well to such other fields as processing equipment of all types, service facilities, office facilities, or even complete plants.

Our concept of the term "rental" covers use of equipment or a facility for an indeterminate period which could be a few days, two months, or even one to two years. The period, however, will bear little or no relation to the economic life of the item. A lease, on the other hand, covers use for a predetermined period of time which might well be 60, 80, or even 100 per cent of the estimated economic life of the item. Depending on the elapsed time of use anticipated, an analysis serves in deciding whether one should rent, lease, or buy.

### Rental Versus Purchase

Rental charges are usually expressed in terms of dollars per day or month, dollars per thousand units produced, or other compatible bases. The charges stated in a rental contract will be substantially greater than the unit cost derived by dividing the initial cost by expected life measured in months or productivity. This is understandable, however, as the rentee must gamble on recovering his investment from a number of such uses, separated by periods of idleness of indefinite duration. While the economics of the short term use are important, more often than not flexibility and/or speed are key considerations for such reasons as the following:

1. Fast Changing Technology: Acquisition of required equipment by renting can be an ideal solution when equipment required for a particular installation is of a type which is continuously undergoing development improvement, or when the requirements of the system are changing rapidly. Rental will provide use of the equipment until the newer model comes along or until long range requirements are better known.

2. Relief from Project Preparation: Project preparation in many companies is a time consuming business. Here we are speaking of the documents which must be prepared and approved before any commitment to expend capital funds can be made. A sudden need for equipment not included in a forecast can be taken care of much faster on a rental basis.

3. Bookkeeping and Tax Considerations: There is significant physical work and cost involved in setting up assets on the books, maintaining depreciation records, and determining appropriate depreciation charges. This also includes periodically inventorying to check the existence of the asset and reporting of the value of assets for tax and earnings reports. Renting eliminates the need for such records and saves effort for all concerned, particularly when a short term use is implied.

4. Ease of Acquisition and Disposal: It is comparatively fast and easy to acquire and dispose of rental equipment. Rentals offer advantages for those installations where early start-up is imperative to maintain a temporary competitive position, get a head start on the market, or provide additional customer service. In addition, one-shot market promotion type products, such as those requiring special packaging machines, semiworks operations, or market research proposals, can be financed on a rental basis with little tie-up of capital and comparatively little risk.

5. Owner's Interest and Service: When one embarks on a rental venture, the owner of the equipment is essentially in

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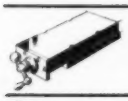
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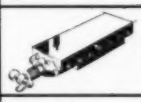
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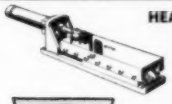
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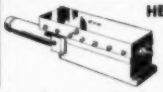
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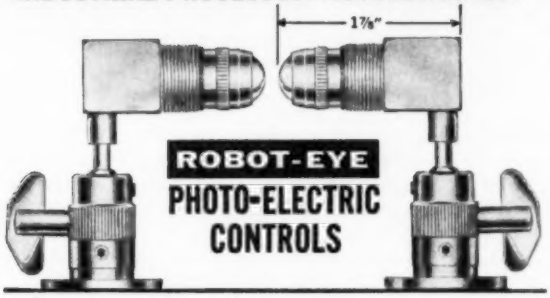


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partnership with you and in many cases will take care of or service the facility so acquired. Often he will take full responsibility for maintenance and upkeep, providing specially trained service people to give continuity of service on the plant site.

6. Better Facilities: In a number of cases, warehousing being a prime example, building facilities are available on a rental basis which are better located or otherwise equipped to give better service than can immediately be duplicated on an ownership basis.

### Lease Versus Purchase

There are several compelling reasons for using lease contracts. In the following list of such reasons, the first two are major points favoring use of lease contracts.

1. Conservation of Working Capital: Many companies, faced with the need to expand production or replace obsolete equipment, find themselves in an awkward financial position. This could include lack of funds, unwillingness to dilute their ownership in the business, or having already extended themselves to the point that their credit is shaky. In such cases, the lease type contract may offer a solution to their problems. The physical equipment and other facilities required are taken on a lease basis, thus conserving available cash or credit to finance their related working capital requirements.

2. Protection of Return on Investment: Many companies have required rates of return on their capital investment substantially higher than the cost involved in borrowing money in the financial market place. In such cases, leasing of facilities from outside companies, who calculate their lease charges on the low rate of interest, will maintain the high rate of return on company investment.

3. Easier to Sell: This point is partly psychological. When part of a required investment can be covered on a lease basis, the selling effort required to convince the operators of the business of its soundness is substantially reduced.

4. Specialized Services: In many situations you can get, with a minimum of effort on your part, not only the facility required, but also much of the related maintenance or other service including, in some cases, operators.

5. Ease of Acquisition or Disposal: Under a lease arrangement you move into the facility or take delivery on the required equipment when you need it, and move out or return it to its owner when your need for the facility is completed. While you use the facility, the owner has the responsibility for problems, depreciation, taxes, asset records, and even maintenance and upkeep.

6. Labor Situation: One by-product of leasing such facilities as warehousing is the lower probability of a tie-up of your goods in case of a strike. An owner whose goods are being handled through leased warehouses operated by a leasing agency can get access to those goods, even under strike conditions in his own plants or the particular warehouse.

7. Industrial Parks: Many communities, counties, or states have made available to industry attractive facilities, developments, and the like to encourage employment in their general vicinity. These facilities, in some cases, include fully developed manufacturing sites with all services, as well as conveniently located distribution facilities and established raw material supply. Use of such facilities can save the expense of exploration, arrangement for construction of plant and services, and all related acquisition expenses.

*From a paper entitled "How Do You Pay for New Equipment—Lease, Rent, or Purchase?" presented at the National AMHS-SAM Materials Handling Conference, Cleveland, June,* 1959.

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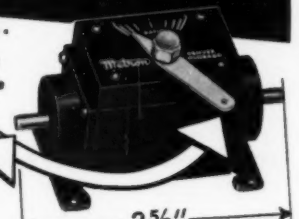


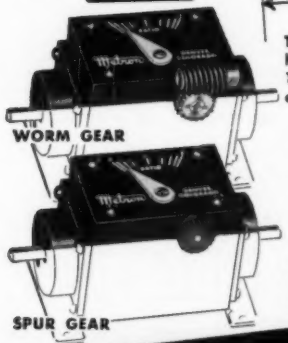


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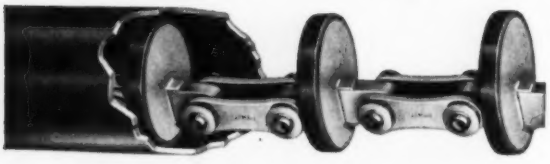

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### PRINCIPLES OF ENGINEERING ECONOMY

*By E. L. Grant, professor of economics of engineering, and W. G. Ireson, professor of industrial engineering, Stanford University; 574 pages, 6 by 9 inches, published by Ronald Press Co., New York; available from* AUTOMATION; $8.00 *postpaid.*

There is a widespread interest in the economic considerations of equipment acquisition and related topics. This fourth edition includes a chapter covering income tax considerations in decision making. The author stresses the value of the "discounted cash flow" theory in evaluating the differences between alternative plans. The book is divided into three major parts: Planning Economy Studies for Decision Making; Interest—the Time Element in Economy; and Techniques for Economy Studies.

## Industrial Publications

### ZENER DIODE HANDBOOK

*Available from International Rectifier Corp., El Segundo, Calif.; paperbound, 96 pages, 6 by 9 inches, illustrated;* $2.00.

Proceeding from an introductory chapter devoted to semiconductor theory, the handbook covers design considerations, thermal and operating characteristics, ac application, dc application, audio and RF applications, and computer and instrumentation applications of zener diodes. A chapter is devoted to a description of various types of zener diodes manufactured by International Rectifier Corp., and typical applications of the several types.

### SERVO ENGINEER'S HANDBOOK

*Available from Daystrom Transicoil, Div., Daystrom Inc., Worcester, Pa.; paperbound, 125 pages, 6 by 9 inches, illustrated;* $3.00.

This handbook covers the following components: Servomotors, rate generators, synchros, gear trains, and servo amplifiers. Other chapters are devoted to general considerations in applying and designing servo systems and a discussion of environmental testing.

### FORGING PRODUCT INFORMATION

*Available from Technical Publications Dept., Kaiser Aluminum & Chemical Sales Inc., 1924 Broadway, Oakland 12, Calif.; 322 pages, 5¼ by 8¼ inches, illustrated; upon request.*

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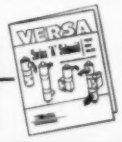


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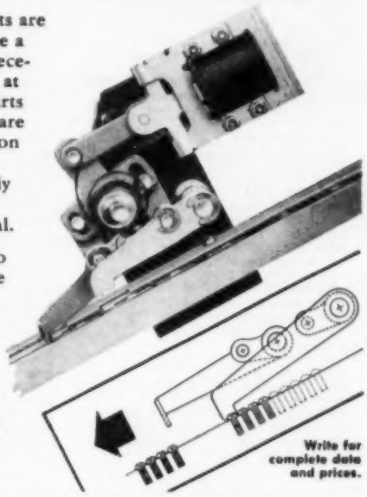

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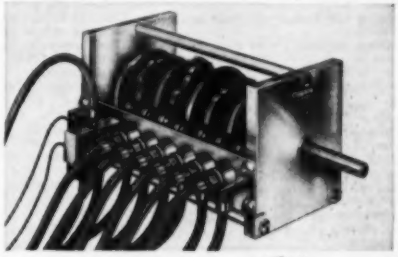

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Uninterrupted Bulk
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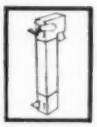
PARTS FEEDING CONVEYOR

A single TUBE-VEYOR can be used to remove chips continuously from any number of machines, effecting important economies. Standard TUBE-VEYORS can handle up to 1000 cubic feet per hour. Whatever your requirements: Any free flow material, such as chips, sludge, sand, flour, shot, coal, etc., can be moved most efficiently with TUBE-VEYOR.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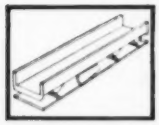
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In addition to being liquid tight, the TUBE-VEYOR has an exclusive two-directional chain which prevents distortion or twist and allows conveying in a variety of directions with no transfer points . . . positive material flow.

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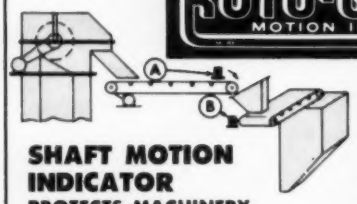
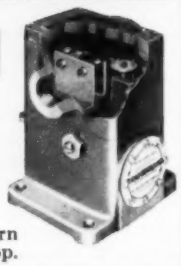
ROTO-GUARD
MOTION INDICATOR



SHAFT MOTION INDICATOR
PROTECTS MACHINERY BY INDICATING STOPPAGE DUE TO OVERLOADING OR MALFUNCTION



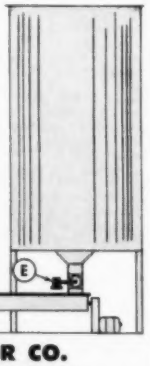
A and B: On end return idlers, warn if conveyor should break, slow or stop.

C: On boot pulley, signals slowdown, stoppage, slippage due to overload, boot pulley out of adjustment. Helps prevent fires.

D: On screw conveyor, warns of slowdown due to overloading. Prevents damage.

E: On rotary feeder, warns of slowdown; prevents plugging damage.

Roto-Guards can be wired into interlock system; stoppage of one component automatically stops others; prevents damage.



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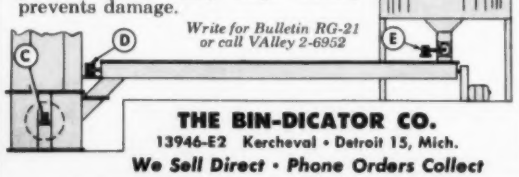
or call VAlley 2-6952



THE BIN-DICATOR CO.
13946-E2 Kercheval • Detroit 15, Mich.
We Sell Direct • Phone Orders Collect

Circle 756 on Page 19

are you stuck?

# confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 2022-P

## BOTTLE ORIENTING

. . . We have an urgent problem concerning the indexing, or orienting, of a gallon bottle (with handle at neck) in a labeling machine. The bottle is in a horizontal position as it passes through the labeling machine. We now place the bottle on an inclined runway feeding the machine and it is manually rotated to a certain orientation before release, permitting a label pickup as desired on the bottle. We desire to orient the bottle automatically . . .

**Vice President**

CASE 2025-P

## PRESS HANDLING

. . . We have two operations in our plant which we believe can be improved with the use of handling devices. In the first operation, coiled stock is dereeled and fed into a blanking press after passing through a power-roll straightener. The blanking press is tripped manually, and the blank is removed from the die manually. We are interested in a means to remove and stack the finished blank; as the blank is removed, stock should be automatically advanced and positioned, after which the press should trip. In the second operation, the blanks, of various sizes and shapes, are passed through a level-rolling machine, with one man feeding the machine and a second man stacking the blanks on a skid. For this operation we are interested in means to automatically feed and/or stack the blanks . . .

**Works Manager**

CASE 2023-P

## TRANSISTOR WELDING

. . . We are in need of information on automatic thermocompression for welding of top hat transistor devices and, also, sources of available commerical equipment for such operations. Any information would be greatly appreciated . . .

**Electronics Manufacturer**

CASE 2021-P

## ELECTRONIC PARTS FEEDERS

. . . For years we have been on the lookout for an automatic handling device that will feed axial lead electronic components (diodes, capacitors, resistors, etc.) from a hopper to a testing station one at a time—the components having been poured into the hopper in a random fashion. We would be most pleased to be placed in touch with anyone who has any ideas for a practical device of this type . . .

**Test Equipment Dept. Head**

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Well financed company, with excellent reputation in automation field, wants man to take full charge of shop. Excellent facilities, including such equipment as jig boring, heat treating, plating, etc.

Must be thoroughly experienced in design, manufacture, and sale of hoppers, parts feeders, elevating devices, orienters, etc.

Excellent opportunity for man who qualifies. Please send resume to KDI Corporation, P.O. Box 130, Cincinnati 12, Ohio. All replies will be held in strict confidence.

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Parke, Davis & Company has an excellent opportunity, with a promising future, for a Senior Design Engineer. This engineer must be capable of exercising ingenuity and creative thinking, and he must assume full responsibility for complete projects. Assignments will require engineering and practical skill in the design and development of special machines to mechanize the research and production of pharmaceuticals. Many of the projects will be in the field of packaging machinery.

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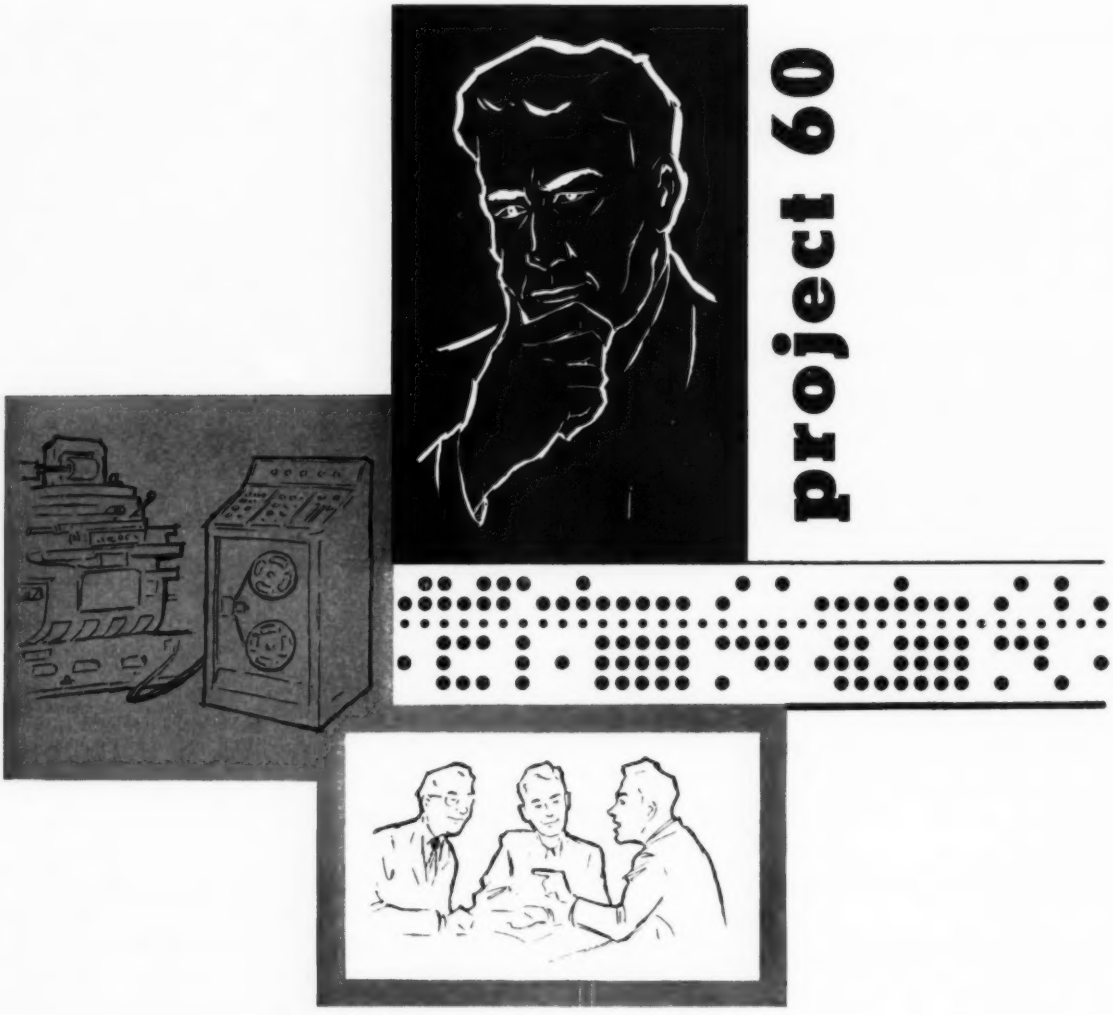
AMERICAN CANCER SOCIETY



project 60

directed to industry's men of decision

PROJECT 60 will present industry's latest developments in numerically controlled machines. This exciting editorial section will appear in the August issue of AUTOMATION. It will keynote the 1960 Machine Tool Exposition and Production Engineering Show to be held in Chicago, September 6-16.

PROJECT 60 will report today's progress and predict the future potentials of numerical control in industry. Top management, manufacturing engineering, and production executives will gain a broad, fresh, new approach to the use of numerical control on production equipment.

**Watch for PROJECT 60 . . . along with other outstanding editorial features in the August issue of**

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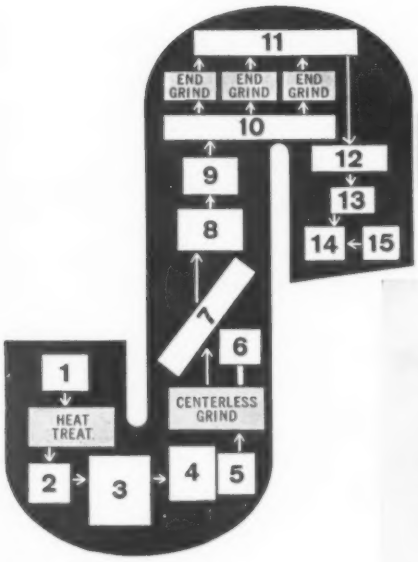
# NOW... RCA Electronic Gaging Modules for "Do-It-Yourself" Instrumentation




Flow diagram showing typical applications of

**RCA AUTOMATION**

1. RCA Floor Feeder
2. RCA Elevating Orienting Feeder
3. RCA Automatic High-Speed Hardness Testing Machine
4. RCA Floor Feeder
5. RCA Rotary Hopper
6. RCA Grinder Control
7. RCA Transfer Conveyor
8. RCA Non-Mar Feeder
9. RCA Mechanical Orienting Machine
10. RCA Demand-Feed Conveyor
11. RCA Conveyor
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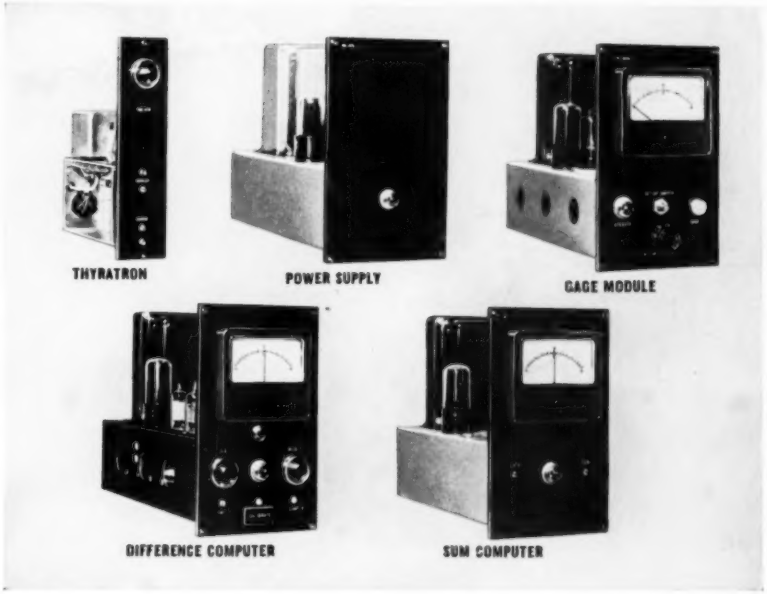
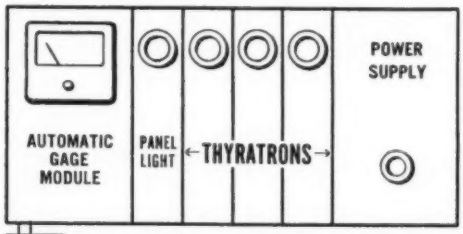
13. RCA Non-Mar Feeder
14. RCA Automatic Assembly Machine
15. RCA Vibratory Feeder




With these standard precision-engineered electronic modules, now available from RCA, you can build automatic systems to meet your exact gaging needs.

Easily assembled, such systems offer high reliability, 100% repeatability, and unusual accuracy. These same modules are now being incorporated in numerous RCA automation systems in use throughout the metal working industry, in such applications as automatic grinding controls, hardness testing, and the inspection of pistons, pins, ball and roller bearings.




Typical application for checking O.D. in four classifications. More complex systems can be assembled by incorporating additional modules such as a DC-7 Difference Computer and Sum Computer.

**AGMC GAGE MODULE** (includes gage head and coaxial cable): transforms the electronic changes caused by displacement of a gage tip into a directly useable signal requiring no amplification.

**ATM THYRATRON:** energized by AGMC output, provides a limit signal used directly for actuating segregating gates and marking or stamping devices.

**APS POWER SUPPLY:** feeds up to five thyratron modules.

**DC-7 DIFFERENCE COMPUTER:** subtracts signals from AGMC units and provides a reject signal. It is used for calculating taper, parallelism, squareness, and similar characteristics.

**SC-7 SUM COMPUTER:** calculates over-all dimensions determined by individual measurements of two segments.

*Write for further information.*

**RADIO CORPORATION of AMERICA**

INDUSTRIAL AND AUTOMATION DIVISION
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Tmk(s) ®

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Circle 652 on Page 19

# ASCO Close-Differential Relays provide dependable, low-cost protection from under and over voltage.

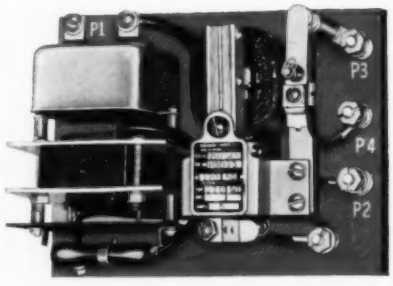
When a motor runs on low voltage for an extended period of time, burnout and fire may result. This can be costly in both down-time and damage to equipment.

You can protect your motors with ASCO Close-Differential Relays. They offer economical, dependable protection even when motor feedback conditions prevent ordinary potential relays from detecting changes in voltage. ASCO Close-Differential Relays respond to a 2% variation in voltage; protect motors when low voltage or over voltage conditions occur.

Because they combine sensitivity with rugged construction, ASCO Relays are providing low-cost protection in a wide variety of applications.

For example, in some oil burner installations, ASCO Relays help prevent explosions due to under voltage. In these installations, when under voltage occurs, ASCO Relays prevent oil build-up in the pit by detecting this low voltage condition, and causing oil flow to be cut off immediately. Otherwise on under voltage the oil would build-up in the pit since the ignition system would not fire. This excess oil could result in an explosion when voltage is restored and the ignition system fires.

Find out how the ASCO Close-Differential Relay can protect your equipment. Send for Catalog 57-S4 describing the complete line of ASCO Relays.




ASCO Close-Differential A-C Relay operates on 2% variation in voltage—features positive action, quiet operation, power relay type contacts.

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